LARS Information Note 022675

PURDUE/LARS DIGITAL DISPLAY USER'S GUIDE

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PURDUE/LARS
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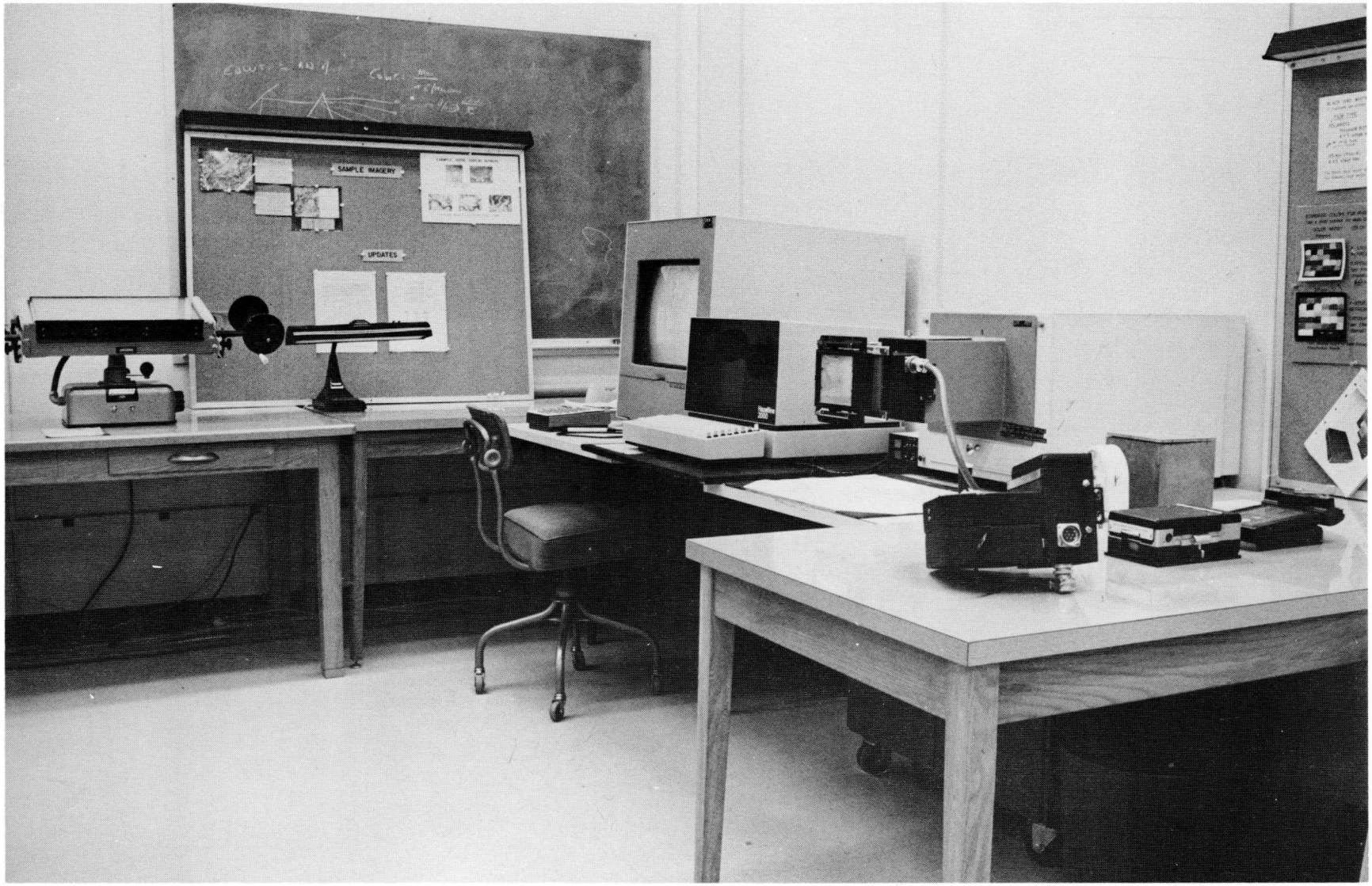

Frontispiece

The Digital Display Area

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ABSTRACT

To acquaint new users with the digital display system, as well as to refresh and enhance the knowledge of those already familiar with its usage, the Purdue/LARS Digital Display User's Guide was created. It is a comprehensive manual incorporating all the information needed to control and to make efficient use of the 4507 digital display and its associated hardware. Included in the text is a description of the digital display system and its capabilities, utilization of the display (both hardware and software), advanced theory and techniques, as well as a comprehensive photographic operations manual.

*The development of this document was sponsored by the LARS Computational Facility established in February 1975 as a self-supporting enterprise of Purdue University. The author is the Digital Display Technical Assistant in the Computational Facility. This publication supersedes the Digital Display Photographic Operations Manual, LARS Information Note 101574. The development of the original document was supported by NASA Grant NGL 15-005-112 and Contract NAS9-14016.

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INTRODUCTION

1.0 Description and Purpose

The analysis of large volumes of data (such as aircraft and satellite data) often makes it desireable to have a visually clear and easily accessible means of viewing the data as a whole. For this purpose the IBM 4507 digital display is employed at the Purdue University Laboratory for Applications of Remote Sensing.

A display device such as this helps reduce the often overwhelming volumne of these types of data sets and presents them in a concise framework, visually acceptable for more rapid and convenient analysis. It provides a qualitative means of monitoring the analysis procedures by furnishing an easy way to display any portion of a frame of data.

The digital display system designed solely for LARS by IBM, consists of a (pair of high resolution)black & white T.V. monitors (one for manual interaction and the second - a slave unit - for photographic purposes). These monitors are linked via their control unit to an IBM 360/67 general purpose, time - sharing computer and can be interactively controlled by a display user through various computer programs available in the LARSYS software system.

The digital display is intended for the use of LARS personnel who would find it a helpful tool in their research. The suggestions and regulations regarding its usage are set forth in this guide.

2.0 Education of Personnel

In order to maintain efficient, high quality photographic output from the digital display photocopy unit, training of all new display users will be required and given on two separate levels. The level of education will be decided by that person's supervisor and the pictorial interface supervisor. It will be the responsibility of the pictorial interface supervisor to see that each new person is properly trained in the usage of the digital display equipment according to the description below:

The two educational levels are:

Level 1 -- General usage of the digital display and discussion of its capabilities. Included are polaroid camera usage as well as black and white and color enhanced photographic methods.

Level 2 -- In addition to the aforementioned skills, the user will be shown proper operating techniques for the 35mm and 4x5 camera equipment as well as usage of the positive-negative polaroid film. Additional principles of digital display photography will be stressed.

Any person trained in the use of LARSYS may be given a level 1 education with unlimited usage of the digital display and polaroid camera equipment. However, level 2 training will be limited to those personnel recommended by their supervisor and approved by the pictorial interface supervisor. If a trained photographer is not available to produce some needed imagery, the pictorial interface supervisor may be contacted to perform the needed services at a standard service charge. Notification for such work should be done as far in advance as possible.

3.0 Operational Procedures and Goals

1. Availability

The digital display will be in operation during the normal operating hours for the Purdue/LARS computer. Any schedule deviations will be posted on bulletin boards and in the news service of the LARSYS system.

2. Reliability

In addition to the expected reliability of the computer system (see Page 5 - LARS Computational Facility User's Guide - LARS Information Note 110475), the digital display should experience no more than an average of one hardware failure per week. The average duration of such a non-functional state should be no greater than one working day.

3. Special Services

A. Trained personnel (generally a computer operator) will be available whenever the system is in operation to assist in diagnosing, reporting, and if possible, solving display operational problems. If additional help is needed, either the pictorial interface supervisor or the computer operations supervisor should be contacted.

B. These same personnel are also trained to assist in any camera problems which may occur as well as to load fresh 35mm film as needed.

C. Polaroid film (Positive-negative - type 105, black and white - type 107 and color - type 108) for use with the digital display camera equipment will be available whenever the system is in operation through either the pictorial interface supervisor or the senior computer operator on duty. For other types of film and information contact the pictorial interface supervisor.

D. 35mm film - Ektachrome-X (color) - will be loaded in the camera at all times and ready for use during operational hours. Plus-X (black and white) film will be loaded upon user request at any time by the pictorial interface supervisor or a trained computer operator.

E. Scheduled processing of 35mm color film will be provided at least once a week. Currently the film is unloaded by noon each Monday. The processed images should be returned to each user within 4 working days. For special or rush processing of 35mm color film and processing of 35mm black & white, and 4x5 film, the turnaround time should be the same; however, please contact the pictorial interface supervisor as far in advance as possible.

F. General information, camera settings and updates concerning the display will be posted on the digital display bulletin boards in the display area.

4.0 Administrative Procedures

In addition to the charge for total CPU time discussed in the LARS Computational Facility User's Guide (LARS Information Note 110475) all accounts will be charged for the time they are attached to the digital display.

All accounts will also be charged for the amount of standard polariod film used. This includes Polapack types: 105 (Positive-negative), 107 (black and white), and 108 (color). There is no charge for initial processing of 35mm imagery. All of the above charges are handled in the same manner as the computer time cost.

PART I

THE DIGITAL DISPLAY SYSTEM

1.0 The Digital Display Environment

1.1 Primary Uses of the Digital Display System

The IBM 4507 Digital Image Display System is available to all LARS analysts to assist in their research. While it is recognized that individual project needs may require many various uses of the display system, there are several main functions which it may serve to aid in the types of analysis commonly done here at LARS. These uses include:

A. DATA QUALITY CHECK

The digital display will generally enhance any quality problems with the data which might not be readily noticeable when viewed using other forms of output.

B. SELECTING TRAINING OR TEST FIELDS

The display can be used to locate fields for use in other LARSYS processing functions. Once selected the fields boundaries will be outlined on the screen (convenient for obtaining hardcopy images of their location) and their coordinates punched onto a Field Description card for input into future programs.

C. LOCATING AREAS OF INTEREST

The display is often of help in trying to locate features which may not be easily identifiable from printer output.

D. PRODUCING IMAGERY

The photocopy unit is used to take both black and white and color imagery in various forms of the data with or without boundaries outlined and titles entered.

These suggestions are by no means restrictive. The sections which follow hopefully will give the user sufficient knowledge of the display system and its capabilities so that he can implement it to best enhance his work.

1.2 System Capabilities

The LARSYS software system is accessed by means of an IBM System 360 Model 67 computer controlled by the CP-67 resource sharing control system and the Cambridge Monitor System (CMS) as

an operating system. Access to LARSYS, even from remote sites, is provided through this combination of hardware and software. However, at present only the users' area at LARS - Flexible Lab 2 has a digital display device controlled primarily through the LARSYS system.

Operation of the digital display itself is flexible to a large extent since it is controlled by several computer programs, each handling the display in a different manner to most efficiently utilize it for their various needs. These programs determine what data is to be displayed, in what manner, and how to interpret input from the various display devices (lightpen, keyboard, terminal).

Photocopy unit (PCU) operation runs in conjunction with the main display unit. The same information which appears on the main screen also appears simultaneously on the PCU screen. The photocopy unit has the capability of producing imagery of the featured scene by means of various camera attachments. By using color filters between the photocopy unit and camera, color coded (classification) or synthesized color images can be produced. Film advance and shutter speed operations can be controlled at the photocopy unit or remotely (for the 35mm camera only) via the PHOTO program.

The main capabilities of the digital display and photocopy unit can be summed up as follows:

A. Continuous motion (for image searching) and still picture governed by the user's display keyboard inputs.
B. Lightpen inputs for channel or boundary selection and enlargements of chosen areas of the displayed image.
C. A flexible command insertion device (the display console keyboard) which is programmed to transmit different commands to the computer for each of the display programs.
D. An easily accessible, high quality arrangement for photographing the displayed image.
E. The ability to produce color coded or synthesized images using grayscale data.

1.3 The Digital Display System Hardware

The digital display system consists of:

- console control unit (CCU)
- display console (DC)
- photocopy unit (PCU)

The console control unit (located in the computer room) provides an interface between the computer and the display units (DC and PCU). The display console in the user's area is the man-machine interface with data displayed on the monitor (main screen) and the user communicating with the computer via the terminal, lightpen, and keyboard. Located near the DC is the photocopy unit which is used to generate hardcopy prints for recording the desired output.

1.3.1 The Console Control Unit

The console control unit accepts control and display data from a LARS reformatted data tape and buffers the data to be displayed in its disk storage unit since the rate of data display is beyond the capability of most computers. The display disk provides the capability of storing slightly more than two frames of data. The control unit also transfers lightpen data (on operator command) and display console keyboard information.

1.3.2 The Main Display Monitor

The display console consists of a high resolution TV monitor, console keyboard, terminal and lightpen. The monitor is a 21" rectangular TV screen (12" x 16" viewing area) which displays a 577 line by 768 sample (column) matrix, each element of which can have one of 16 possible graylevels. Contrast, brightness, and movement controls for image quality are also accessible. The image is rewritten on the screen 30 times per second in a field interlace fashion. The image has the ability to roll gradually to allow new data to be displayed. This is done by automatically increasing the first line address, displacing each of the lines of the frame correspondingly while adding new data lines at the bottom of the screen. The maximum roll rate is 120 lines per second.

1.3.3 The Display Console Keyboard

The display console keyboard has a row of 8 sensing switches at the top of the device and 32 keys (numbered 0-31) which are depressed to signal program functions to the computer. Each plastic overlay has 32 holes that fit over and provide a label for each of the 32 function keys. It also shows the assigned number for each key with space allotted for a descriptive function title. Figures 1-1 and 1-2 show the keyboard overlays for IMAGEDISPLAY and PHOTO respectively.

Only one key can be depressed at a time. Any depressed key must be fully released before pressing another key or the second message will not be transmitted. There is also danger of "hanging-up" the program (see section 3.4.5).

1.3.4 The Lightpen

The lightpen operates by pressing it against the face of the display console monitor. This results in a transfer of the coordinates of the light pen position to the computer.

A second input point should not be made until the first point is registered. The point is registered when, after the screen brightness is momentarily intensified, a point consisting of several pixels (depending on the program being used) appears on the screen where the lightpen was activated. As with multiple keyboard entries, an overload of lightpen inputs can cause the program to "hang-up" (see section 3.4.5).

The lightpen presently performs four main functions:

1. Channel selection - 1-point input. Available in IMAGEDISPLAY only. For details see section 2.1.2.1.

2. Single point coordinate status - 1-point input. Available in IMAGEDISPLAY only. For details see section 2.1.2.2.

3. Enlarge picture function - 4-point input to define a rectangular boundary. Available in IMAGEDISPLAY and PHOTO. For details see section 3.2.3.

4. Edit field function - 4-point input to define a rectangular boundary. Available in IMAGEDISPLAY only. For details see section 3.2.3.

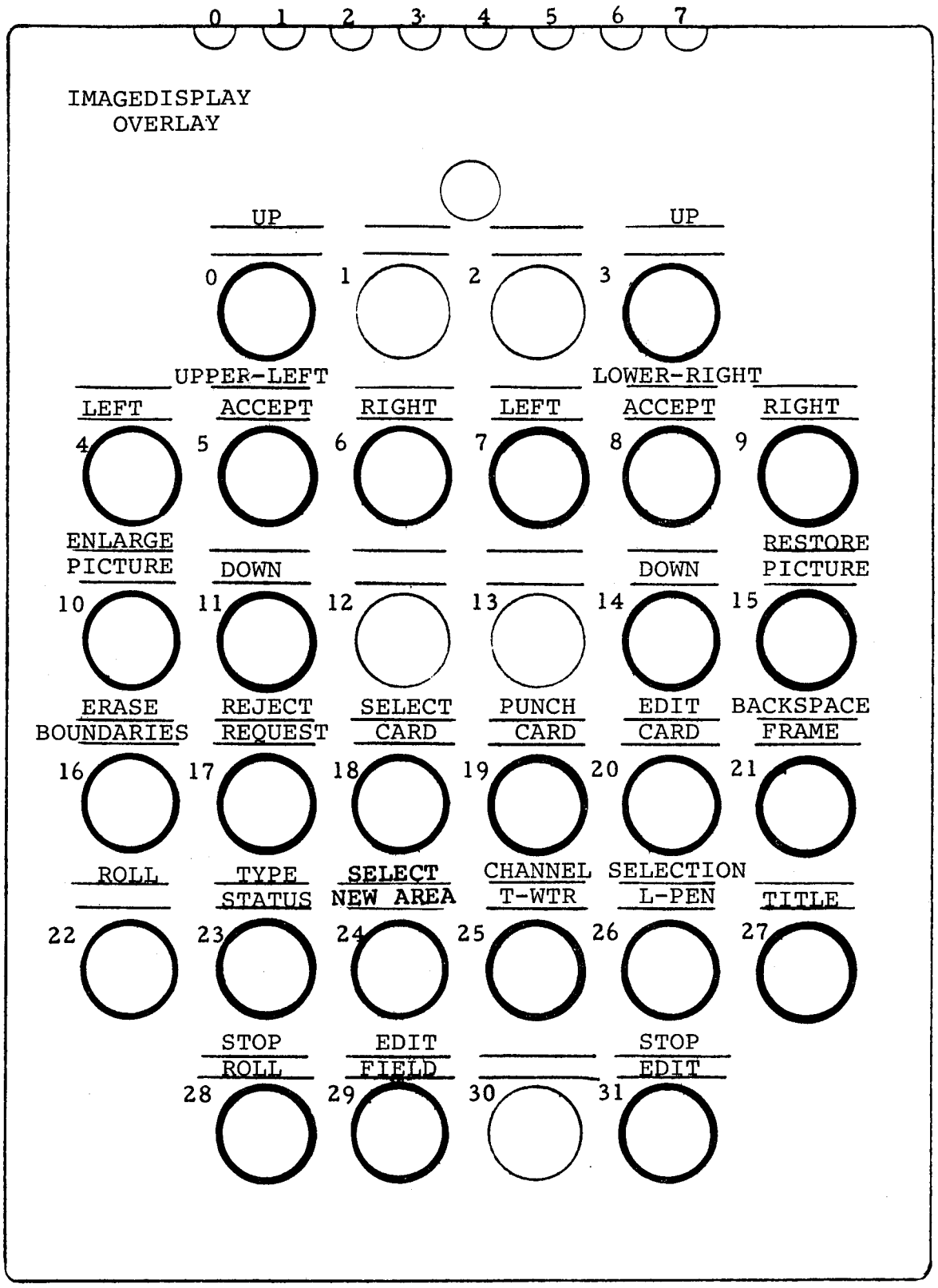


Figure 1-1

The IMAGEDISPLAY Keyboard Overlay

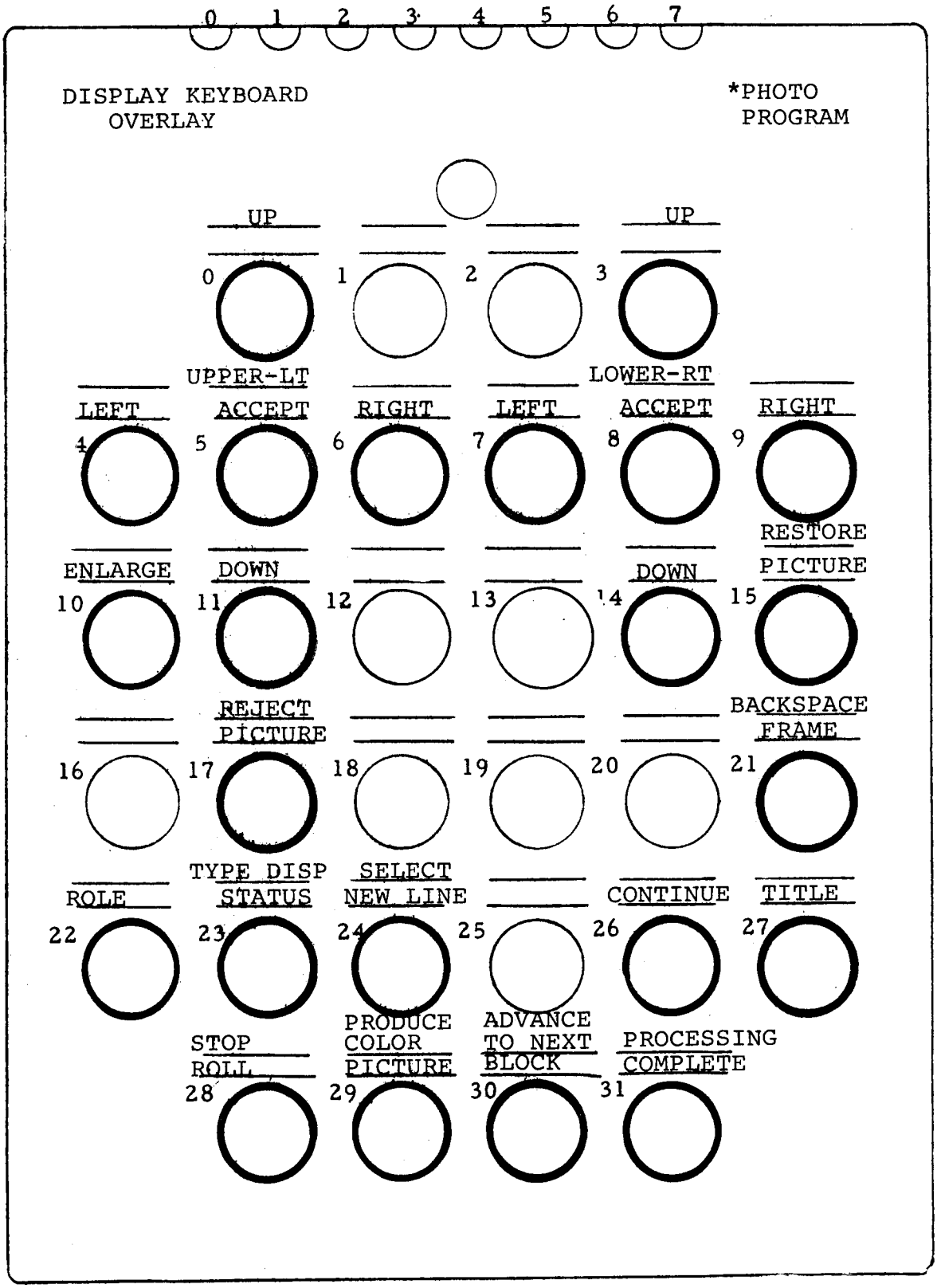


Figure 1-2

The PHOTO Keyboard Overlay

1.3.5 The Photocopy Unit

The photocopy unit contains a 17" high resolution TV monitor which displays the same image as the main display screen. Only a 6.25" x 4.50" rectangle in the center of the photocopy screen is used to display the image. Photographs of the scene can be taken using polaroid, 35mm, or 4x5 sheet film with the proper camera attachments provided. Further information about the photocopy unit is contained in Part II of this manual.

1.4 Programs Controlling the Digital Display System

There are three standard programs available under LARSYS for operating the digital display:

IMAGEDISPLAY - to be used when looking at multispectral scanner data to check data quality, edit rectangular fields, locate scene features, obtain photography.

PHOTO - to be used with classification results only to check data quality, locate scene features, and obtain photography. With this program, the 35mm camera can be used in the remote mode. See Part II, Section 3.1 for more information.

COLRCHRT - to produce copies of the color coded chart to show the range of 32 colors for use with the PHOTO program. It also serves as a check of color stability over a period of time.

Detailed information regarding each of these programs can be found in the following references:

PROGRAM	REFERENCE	LOCATION
IMAGEDISPLAY	LARSYS Users' Manual	Terminal Area, Flexlab II
PHOTO	LARSYS Abstract #649	Digital Display Area, Flexlab II
COLRCHRT	LARSYS Abstract #664	Digital Display Area, Flexlab II

1.5 Operational Procedures

This section describes operation of the display system. The description centers about the operation of the digital display hardware, its interface with the user, and its interface

with the computer at the channel program level. The user controls the digital display system via the display console, the photocopy unit, and the LARSYS programs.

1.5.1 Modes of Operation

There are three modes of operation available for LARSYS users (batch, interactive and disconnect). Display control requires the interactive mode for most work. The initialization procedure can operate in the disconnect mode (see section 2.1.1.3). However, from the point where the program requests the display to be attached on, the interactive mode prevails.

1.5.2 Operating the Digital Display

The user conducts operation of the digital display through two phases for every program run. They are:

initialization - consists of terminal, tape and/or control input.

interactive - active control of the display via the terminal, keyboard, lightpen and photocopy unit controls.

1.5.2.1 Initialization

During the initialization process, the user will require one or more of the following inputs depending on the program used:

PROGRAM	PRIMARY INPUT
IMAGEDISPLAY	Computer Cards Terminal Multispectral Image Storage Tape
COLRCHRT	Terminal
PHOTO	Computer Cards Terminal Results Tape

IMAGEDISPLAY

- Run and area to be displayed
- Channels (wavelength bands)
- Graylevel selection for data
- Choice of disk or tape as input
- Field boundaries to be displayed
- Optional printer output
- Optional punch output

PHOTO

- Location of classification results to be displayed
- Number of the graylevel representing each data class
- Number of the color representing each data class
- Area of results to be displayed
- Remote mode of camera operation
- Optional printer output

COLRCHRT

- NONE
- No card input required
- No options to program

The above information should appear in the card input for the initialization phase. After this data enters the computer and is ready for the display, the interactive phase begins.

1.5.2.2 Interaction

This phase begins after the display attach message appears at the terminal. At this point the program has read in all of the cards, completed any histogramming to be done and, if using the disk, transferred all data to the display disk. When this occurs and the attach message appears at the terminal, the data display/editing mode begins.

The user is free to perform whatever functions are available under his particular program. Any lighted key on the keyboard may be used. The only admonition is that the user should not press function key 31 until he wishes to terminate the program. The user may operate the photocopy unit at any time except

when rolling the display image. The following references give detailed instructions on the use of each program:

IMAGEDISPLAY - LARSYS User's Manual

PHOTO - LARS Program Abstract #649

COLRCHRT - LARS Program Abstract #664

Control card listings for each program appear in each computer area. COLRCHRT requires no control cards.

2.0 LARSYS Programs Controlling the Digital Display

This section describes the operation of each of the LARSYS programs designed to access the digital display. Since IMAGE-DISPLAY and PHOTO documentation is extensive, the discussion of these programs in this guide serves only as an enhancement of the original documentation. The discussion of each program in this guide consists of:

Initialization Procedures - lists and discusses briefly all possible input options via control cards, terminal, data tape and disk.

Interaction Procedures - lists and discusses briefly all possible functions which can be performed at the display keyboard in conjuction with the lightpen and terminal.

2.1 IMAGEDISPLAY

The user may obtain more detailed information concerning this program in the LARSYS Users Manual, copies of which appear in the users area of Flexlab 2 and in the remote terminals' computer areas.

2.1.1 Initialization

The following is a description of the required input for the IMAGEDISPLAY program.

2.1.1.1 Program Control Card Deck

The user should set up the input deck according to the control card listing for IMAGEDISPLAY. The input deck may contain the information shown in Table 2-1. The data marked with a '+' are required input cards. The initial cards for each deck should be the ID card followed by *IMAGEDISPLAY. (The user may read in several programs under one ID in which case the *IMAGEDISPLAY card appears as the first for each program after the first.) The user may insert the chosen control cards in any order following these initial cards up to the data decks (if any). The data decks should appear after the control cards in the order indicated on the control card list. The last card of an input deck is always the END card. Figure 2-1 shows the proper deck arrangement.

The following is a brief discussion concerning the usage of each control card:

+ DISPLAY RUN (kkkkkkkk), LINE (x,y,z), COL (x,y,z)
  This card selects the run to be displayed. The optional line and column coordinates specify which subset or portion of the run the user wished to view.

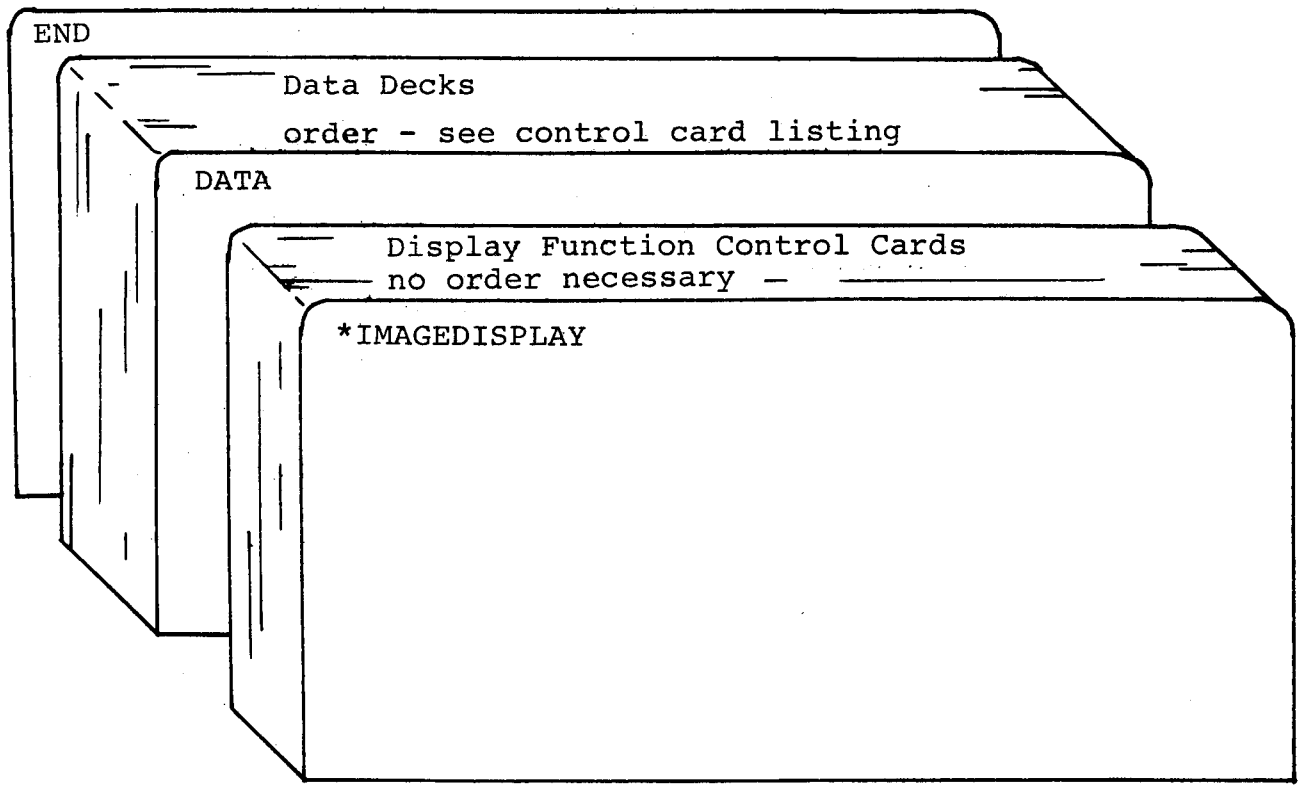


Figure 2-1

The Ordering of an IMAGEDISPLAY
Program Deck

REVISED 12/22/73

LARSYS CONTRCL CARDS

IMAGEDISPLAY

REQ	KEY WORD(CCL.1)	CONTROL PARAMETER	FUNCTION	DEFAULT
+	*IMAGEDISPLAY (NCNE)		SELECTS DIGITAL DISPLAY EDITING FUNCTION.	(NONE)
+	DISPLAY	RUN(KKKKKKKK)	RUN KKKKKKKK WILL BE DISPLAYED.	(NONE)
		LINE(X,Y,Z)	DATA FROM LINE X TO Y WITH INTERVAL Z.	SEE NOTE BELOW
		CCL(X,Y,Z)	DATA FROM COLUMN X TO Y WITH INTERVAL Z.	SEE NOTE BELOW
	CHANNELS	I,J,K,...	CHANNELS I,J,K ARE SELECTED. CARD IS REQUIRED UNLESS 'HISTOGRAM LEVELSCARDS' IS USED.	(NONE)
	SYMBOLS	I,J,...	THE GRAY LEVELS USED FCR THE DISPLAY ARE IN ORDER OF BRIGHTNESS, 2 TO 16 ASSIGNMENTS MAY BE MADE.	PREPROGRAMMED GRAY LEVELS OF INCREASING BRIGHTNESS FOR 16 LEVELS
		NLEV(X)	THE NUMBER OF GRAY LEVELS IS SET TO X BETWEEN 2 AND 16. NLEV MUST NOT BE USED WHEN SPECIFYING USER-SUPPLIED GRAY LEVELS.	X=16
	OPTIONS	NCDISK	DO NOT USE DISK FOR INPUT DATA TO BE DISPLAYED.	USE DISK
	HISTOGRAM	COMPUTE	CALCULATE HISTOGRAM.	COMPUTE
		DISK	USE STORED HISTOGRAMS FROM LARSYS DISK.	
		HISTOCARDS	READ HISTOGRAM CARDS IN DATA DECK.	
		LEVELSCARDS	DATA CARDS WHICH DEFINE THE CHANNELS, CALIBRATION, AND NUMBER OF LEVELS ARE READ AND USED FOR PICTORIAL PRINTOUT.	
	BLCCK		PARAMETERS TO SELECT DATA BLOCK TO BE HISTOGRAMED.	
		RUN(XXXXXXXX)	DATA FROM RUN XXXXXXXX IS REQUESTED.	DISPLAY RUN
		LINE(X,Y,Z)	DATA FROM LINE X TO Y WITH INTERVAL Z.	LINES SPECIFIED ON DISPLAY CARD WITH INTERVAL OF 10.
		CCL(X,Y,Z)	DATA FROM COLUMN X TO Y	COLUMNS SPECIFIED ON DISPLAY CARD WITH INTERVAL OF 10.
	PRINT	HIST	PRINT HISTOGRAM GRAPHS.	NO PRINTING
	PUNCH	HIST	HISTOGRAMS FILE PUNCHED.	NOT PUNCHED

Table 2-1

IMAGEDISPLAY Control Card Listing

LARSYS CONTROL CARDS PAGE 2

IMAGEDISPLAY

REQ	KEY WORD(COL.1)	CONTROL PARAMETER	FUNCTION	DEFAULT
	BOUNDARY	DELETE	DELETES ALL STORED BOUNDARIES FROM THE COMPUTER FOR TRAINING AND TEST.	(NONE)
		STORE	READS FIELD DESCRIPTION CARDS AND STORES BOUNDARIES.	(NONE)
		OUTLINE	OUTLINE STORED TRAINING AND TEST FIELDS ON THE DISPLAY.	(NONE)
		SAVE	SAVE NEW BOUNDARIES CREATED AT THE DISPLAY.	NEW BOUNDARIES NOT SAVED.
	DATA	-----START OF DATA DECK-----	FIELD DESCRIPTION CARDS DEFINING TEST AND TRAINING FIELDS. REQUIRED IF 'BOUNDARY STORE' WAS SPECIFIED. TEST FIELDS FOLLOW A CARD WITH 'TEST' STARTING IN COL. 1, AND TRAINING FIELDS FOLLOW A CARD WITH 'CLASS' STARTING IN COL. 1.	
	DATA	-----START OF DATA DECK-----	HISTOGRAM DECK IF 'HISTOGRAM HISTOCARDS' WAS SPECIFIED.	
	DATA	-----START OF DATA DECK-----	LEVELS CARDS FOR USER-SPECIFIED DEFINITION OF HISTOGRAM LEVELS. REQUIRED WHEN 'HISTOGRAM LEVELSCARDS' IS SPECIFIED. FOR EACH CHANNEL, A CARD WITH FORMAT - CHAN(N),CALIB(I),L1,L2,L3,... SHOULD BE USED. WHERE N = CHANNEL NUMBER, I = CALIBRATION CODE, AND L1 = UPPER LIMIT OF FIRST BIN, ETC.	
+	END	(NONE)	END OF FUNCTION.	(NONE)

NOTE.....IF COL IS NOT SPECIFIED ON THE DISPLAY CARD, THEN COL(X,Y,Z) IS SET TO COL(1,Y,Z) WHERE Y IS EQUAL TO THE NUMBER OF SAMPLES ON THE TAPE AND Z IS SET TO 1 IF Y IS LESS THAN OR EQUAL TO 768. IF Y IS GREATER THAN 768 THEN Z = (Y-1) /768+1. IF THE LINE PARAMETER IS OMITTED, ALL LINES WILL BE SELECTED, WITH THE INTERVAL EQUAL TO THE COLUMN INTERVAL.

If the user specifies no line and column coordinates, then the program displays the entire run. Regardless of the specified "z" coordinate, the data initially appears on the display at the appropriate interval for the size of the data set. The total number of columns specified determines this interval. (See section 4.4 for details concerning the interval selection.) The program then sets the line interval equal to the column interval. Several factors may govern the selection of a subset:

- desired area to be displayed
- disk limitations
- rapid access

Even if the user wished to display only a certain portion of the data frame, he should determine beforehand if the chosen subset is small enough for loading on the disk. In some instances, the user may find it more convenient to work directly from the data tape so that the disk limitation is no longer relevant. Depending on what interaction will occur, either method might give more rapid access. For further information on selection of data, see the various sections under 4.0, "Some Techniques and Approaches".

CHANNELS i,j,k...

This is a required card unless the user inputs a HISTOGRAM LEVELSCARDS. It specifies which of the total number of channels of data the program will make available for display during the interactive session. The user may obtain information regarding the channels for a given run through an IDPRINT or the Data Tape Logs near the users' area, Flexlab 2. The number of channels selected affects the size of the area that can be loaded onto the disk. (See section 4.1). The LARSYS Version 3.2 update now allows a maximum of 30 channels (previously only 16) to be requested.

SYMBOLS i,j,k...

NLEV(x)

There are a total of 16 gray levels which the user can assign to the data set. The SYMBOLS card determines which of the gray levels will represent the data set. I,J,K. . . are numbers from 1 to 16 (black to white) which the program assigns to each group of data points. NLEV(x) indicates the total number of gray levels used (i.e. the number of data groups or divisions. There must be a one-to-one correspondence

between the assigned gray levels and every NLEV specified. If the user does not specify any SYMBOLS, all 16 gray levels will appear in order of increasing brightness corresponding to an increase in spectral response for each channel.

OPTIONS NODISK

This card allows the user to read his data directly from the data tape during the interactive session. (See section 4.2) If this card is not used, the program will load the data onto the disk unless the total number of data points requested is too large to fit on the disk. In this case, he will receive a message at the terminal giving the following options:

- no disk used
- data truncated
- program terminated

The program will then proceed as specified by the user at the terminal.

HISTOGRAM COMPUTE

DISK
HISTOCARDS
LEVELCARDS

This set of commands relates to the computer the location of the histogram information. The first HISTOGRAM option, COMPUTE, is the automatic default if the user does not specify any of the other commands. Therefore, it is not necessary to enter this command. The COMPUTE command requests the computer to calculate the histograms using the area specified in the BLOCK card if there is one. If not, it calculates histograms for the entire area displayed. The DISK option allows the user to implement histograms calculated in the current terminal session since the last 'i larsys' command or a set of histograms stored on his permanent disk if the HISTDECK USE command was issued prior to IMAGEDISPLAY. The HISTOCARDS option reads previously calculated histogram information in card form from the input deck. The LEVELSCARD causes the implementation of user defined values instead of calculating the histograms from the run. The program reads in this information as part of the data deck discussed on the next page.

BLOCK RUN (xxxxxxxx), LINE (x,y,z), COL (x,y,z)

This card permits the user to select any portion of the run for calculating the histograms. The line and column coordinates are optional and necessary only if the entire run is not to be used in the calculation. If this card does not appear, the program will use every tenth line and column of the data block specified on the DISPLAY card for the calculation.

PRINT HIST

This command directs the program to have the histogram graphs for each channel printed.

PUNCH HIST

This command directs the program to have the calculated histograms punched for input into future programs.

BOUNDARY DELETE
STORE
OUTLINE
SAVE

These commands control the input and storage of training and test field boundaries. The user may input field description cards in the standard format shown in figure 2-2, for displaying on the screen during the interactive session. BOUNDARY DELETE erases all stored boundary information previous to the current input. The STORE option causes the computer to read in and store the Field Description Cards on the disk. The program uses these stored values to outline the field area on the display screen using the OUTLINE option. Finally, BOUNDARY SAVE will store boundary information on the disk beyond the present terminal session until the user issues the DELETE command. This includes both the card input and any values created using the EDIT FIELD keyboard command.

DATA DECKS

Figure 2-2 shows the proper format for each of the types of data deck options in IMAGEDISPLAY. Table 2-1 gives the control card format. For detailed information regarding the data contained in the Field Description Card, Histogram and LEVELSCARD data decks the user should consult the LARSYS Users' Manual.

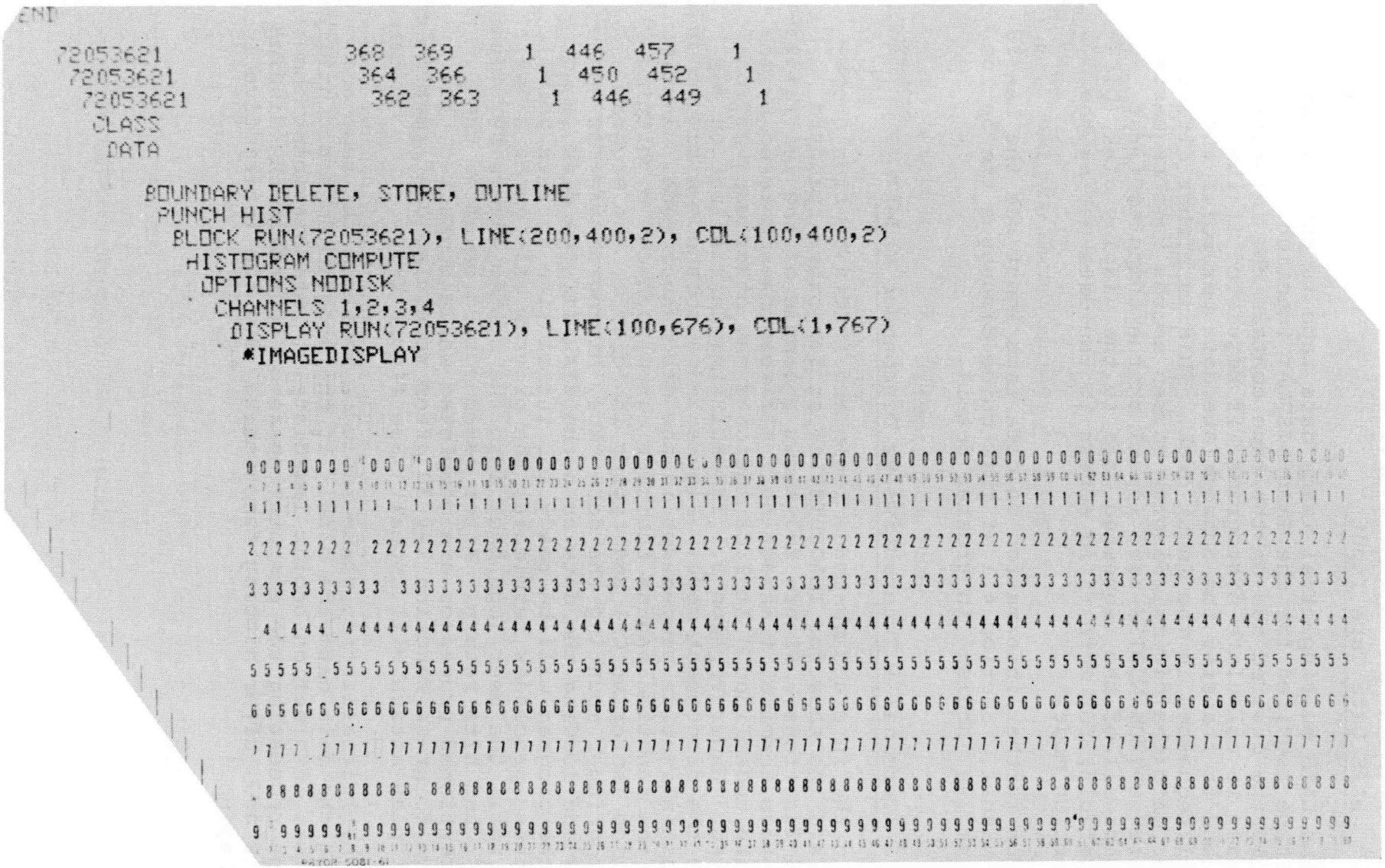


Figure 2-2

An Example of an IMAGEDISPLAY Deck

2.1.1.2 LARS Data Tape Input

The LARS Multispectral image data tape is the standard input tape required for the IMAGEDISPLAY function. The contents of the desired run on the tape contain the information necessary to calculate histograms (if requested in the input deck) and to transfer the appropriate data per point for each channel requested in the input deck. This is either directly written onto the digital display screen as the user requests the data (OPTION NODISK-card input) or the computer first transfers all of the requested data to the display disk (DISK-card default) for more rapid access to the data during the interaction mode.

For further information on data tape input see the LARSYS Users Manual. Section 4.1 of this guide discusses the option of 'disk' vs 'nodisk' in greater detail.

2.1.1.3 Terminal - Interactive vs Disconnect Mode

In the interactive mode, login and initialization procedures are the same for IMAGEDISPLAY as for other standard LARSYS functions. Figure 2-3 shows a sample of the initialization phase terminal transaction. All responses entered by the user are underlined. Italics indicate any other user action required. Under Version 3.1 IMAGEDISPLAY initialization may run in the disconnect mode. Figure 2-3 also shows a sample of the initialization procedures in the disconnect mode. Anytime after the function begins the user can disconnect by hitting attention (entering CP) and typing in 'disc'. The program will continue, mounting the data tape, histogramming (if necessary), and loading the data onto the disk (if the disk is not used the program will be ready for interaction at this point). When these processes terminate, the program will enter a 'wait' state until the user logs back into the system enters CP, types in "b", and hits return. After reconnecting or after the aforementioned processes are completed while connected, the message to press function key 30 after receiving confirmation of the display attach will appear. See figure 2-3.

The initialization phase includes mounting the tape and loading the data onto the disk. If the program does not utilize the disk, interaction begins immediately. At this point the message requesting the computer operator to attach the displa- appears and, after hitting function key 30, the interactive mode begins.

Interactive Mode

```
T=0.78/1.02 13.21.52
run larsys
EXECUTION BEGINS...

I0141  IMAGEDISPLAY FUNCTION REQUESTED    (IMASUP)
 I0002  TAPE     1095 HAS BEEN REQUESTED ON UNIT 0181  (MOUNT)
DEV  181 ATTACHED
 I0003  TAPE READY...EXECUTION CONTINUING    (MOUNT)
 I0036  DESIRED RUN FOUND ... 72063300    (GADRUN)
 I0084  HISTOGRAM(S) READY TO BE PUNCHED.    (HISTD)
 I0034  ALL CONTROL AND DATA CARDS FOR THIS FUNCTION HAVE BEEN READ    (IMAINT)
 I0150  AFTER 'DEV 2A0 ATTACHED' MESSAGE IS TYPED, PUSH FUNCTION KEY 30 TO CONTINUE    (EDTDIS)
DEV  2A0 ATTACHED
```

By pushing function key 30 at this point, the program will resume entering the interactive phase. This is indicated by the terminal message:

```
 I0246  IMAGEDISPLAY FUNCTION CONTINUES..   (EDTDIS)
```

Disconnect Mode

```
T=1.92/2.74 17.41.09
run larsys
EXECUTION BEGINS...

I0141  IMAGEDISPLAY FUNCTION REQUESTED    (IM ASUP)
 I0002  TAPE     1249 HAS BEEN REQUESTED ON UNIT 0181  (MOUNT)
DEV  181 ATTACHED
 I0003  TAPE READY...EXECUTION CONTINUING    (MOUNT)
TAP2 NOT READY YET
(OK - READY NOW)
 I0035  SEARCHING FOR RUN 73062800    (GADR UN)
 I0036  DESIRED RUN FOUND ... 73062800    (GADR UN)
 I0034  ALL CONTROL AND DATA CARDS FOR THIS FUNCTIO N HAVE BEEN READ    (IMAINT)
 I0243        39 OF      1161 LINES TRANSFER RED TO DISK    (ITPDSK)
 I0243        78 OF      1161 LINES TRANSFERRED  TO DI SK    (I TPDSK)
```

Hit the "attn" key ("break" button on the Hazeltine at the terminal) to enter CP.

```
 CP
disc
 DISCONNECT AT 17.48.18 ON 09/24/75

cp-67 online     xd.65 qsyosu
```

When you are ready to reconnect, begin the login procedure. Note that your name is not requested.

```
l dspdev
 ENTER PASSWORD:
 ********
 OPERATORS ARE BRUCE AND JIM
 **USERS SHOULD MAKE SURE THEY DO NOT HAVE ANY FILES IN
 THEIR VIRTUAL MACHINES NOR READ IN ANY JOBS TO BATCH MACHINES
 BEFORE SHUTDOWN FOR PM FRI. IF THERE ARE FILES THEY MAY GET LOST**
 NEXT SCHEDULED SHUTDOWN FRI FROM 0800-1000
 FILES:- 01 RDR, NO PRT, NO PUN
 RECONNECT AT 17.58.43 ON 09/24/75
 CP
b
 I0150  AFTER 'DEV 2A0 ATTACHED' MESSAGE IS TYPED, PUSH FUNCTION KEY 30 TO CONTINUE    (EDTDIS)
 DEV  2A0 ATTACHED
```

By pushing function key 30 at this point, the program will resume entering the interactive phase. This is indicated by the terminal message:

```
 I0246  IMAGEDISPLAY FUNCTION CONTINUES..   (EDTDIS)
```

Figure 2-3

IMAGEDISPLAY - The Initialization Phase

2.1.2 Interaction

The interaction procedures consist of input by the display operator via the terminal, lightpen, or display keyboard. (See Figure 2-4). Once the operator attaches the display, the user can initially control the display through either the lightpen or the keyboard to select a channel.

The functions controlled through IMAGEDISPLAY are discussed fully in the LARSYS User's Manual. Table 2-2 contains a brief description of each of the function keys used. The only items discussed in detail here are the functions revised or added to the LARSYS 3.2 Version update of IMAGEDISPLAY. They consist of a revised initial channel selection, revised image coordinate selection, and lightpen-controlled single point coordinate status.

2.1.2.1 The Initial Channel Selection - Revised

All channel selection, whether initial or keyboard requested, can now be done via either the lightpen or terminal. The only phase altered by this Version 3.2 modification is the initial channel selection formerly controlled solely through the lightpen.

After the display has been attached, keyboard control for the channel selection keys will be available and operate in the same manner as normal channel selection during the interactive session. In this manner, either the lightpen or terminal can be used to specify the desired channel.

In all other respects, channel selection is the same as under previous versions of IMAGEDISPLAY.

2.1.2.2 New Image Coordinate Selection - Revised

This revision is actually an elaboration of the SELECT NEW LINE keyboard function. Formerly, a new initial line value could be entered at the terminal to redisplay the image retaining its present column values.

With the new modification, by pressing the SELECT NEW AREA key, the user can enter the following numerical coordinates, each separated by a comma:

- new initial line value (required)
- new initial column value (optional - required only if last column is to be specified)
- new last column value (optional)

1. New initial line value - This parameter is identical to the former SELECT NEW LINE function. It causes the

present column boundaries to be redisplayed starting at the new initial line and displaying all subsequent available data lines at the present interval or scale until the entire screen is filled or the end of the data set is reached.

2. New initial column value - This new option allows the user to input a new initial column as well as line to be displayed. If the initial column is specified without the third parameter--last column--then the new data set will be displayed at the same interval or scale starting with the specified column and filling the screen completely across or until the last column of the data set is reached.

3. New last column value - When this third parameter is entered, the new image will be displayed--with an initial line and first and last columns as specified--at the appropriate scale for the number of columns selected. See section 4.4 for information regarding this selection.

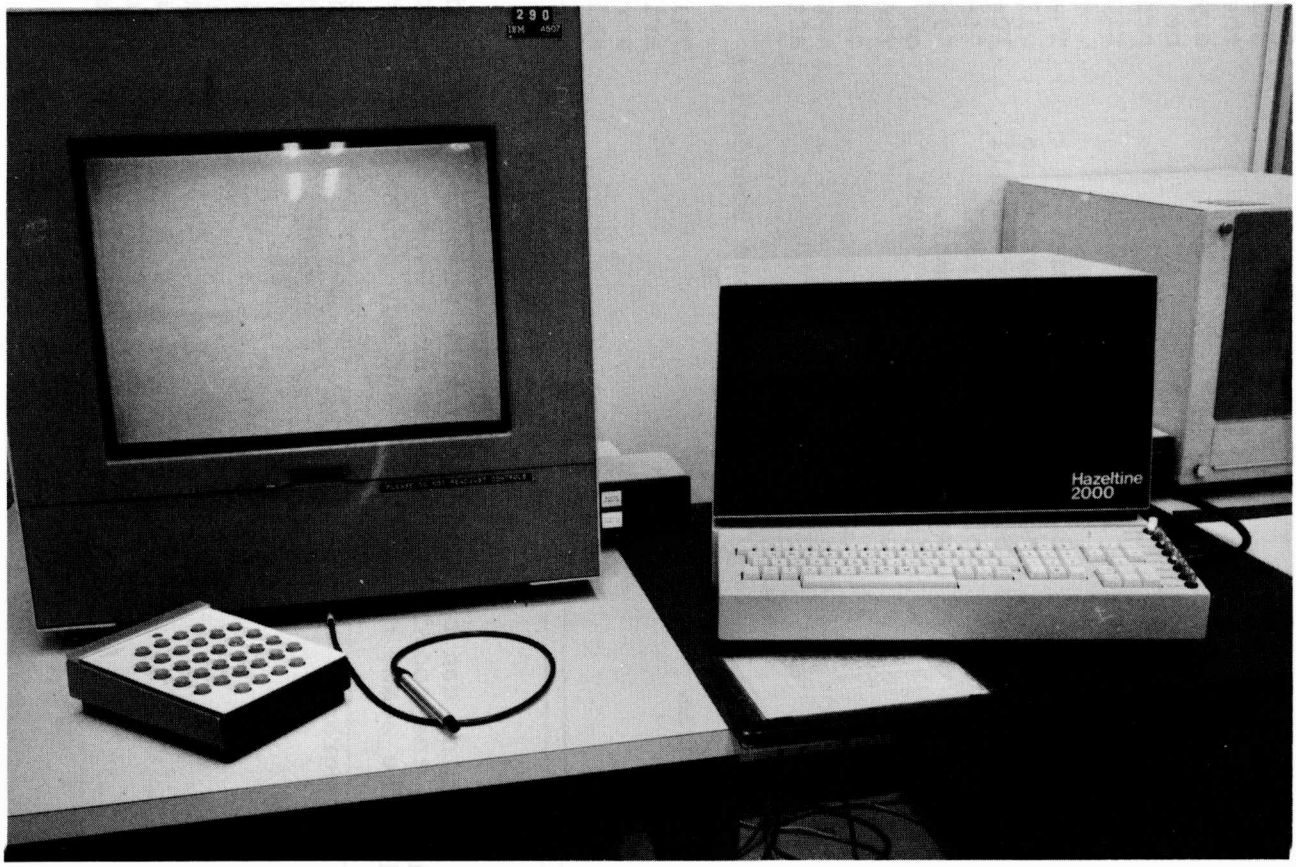
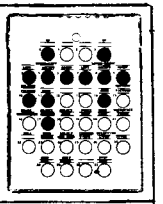
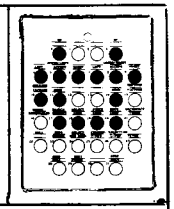


Figure 2-4

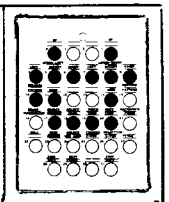
The Digital Display Input Devices

Press Function Key #	Controlling Device	User Action	Response	Function Exit
ENLARGE PICTURE This allows user to visually select a subset of the displayed image to be enlarged using the lightpen				
10	lightpen	Input 4 points defining the rectangular area to be enlarged.	A rectangular boundary will be drawn	Transferred to boundary movement keys
		Boundary Movement Keys		
0 4 6 11 3 7 9 14	Simultaneous control of all 8 function keys as well as boundary accept keys	When pressing any of these keys the following response occurs on the screens: boundary moved / direction upper / up left / left left / right upper / down lower / up right / left right / right lower / down	Rate: 1 line (column) per key press All columns in a line moved simultaneously Each line element in a column must be moved individually causing longer movement time	Each time one of these keys is pressed, control of all boundary movement/accept keys is returned. To exit the function both boundary accept keys must be pressed (See next section)
		Boundary Accept Keys		
5 8	Program	-None- Note: do not press these keys simultaneously.	All keys controlling boundary movement and acceptance go out and the program proceeds to display the new area selected	Automatic-both keys must be pressed
		Reject Request		
17	Program	-None-	Transfers control back to program providing an abnormal, instant termination	

EDIT FIELD This function operates in the same manner as ENLARGE PICTURE. EDIT FIELD, however, allows the user to input 4 lightpen points to define a rectangular field on the screen. The outline of this field remains on the screen after exiting the function and causes a field description card to be punched at the end of the program.	

tion

EDIT FIELD



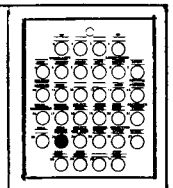
This function operates in the same manner as ENLARGE PICTURE. EDIT FIELD, however, allows the user to input 4 lightpen points to define a rectangular field on the screen. The outline of this field remains on the screen after exiting the function and causes a field description card to be punched at the end of the program.

29	Lightpen	Input 4 points defining the rectangular area to be enlarged	A rectangular boundary will be drawn	Transferred to Boundary Movement/Accept keys
		Boundary Movement Keys		
0 4 6 11 3 7 9 14	Simultaneous control of all 8 function keys as well as boundary accept keys	When pressing any of these keys the following response occurs on the screens: boundary moved / direction upper / up left / left left / right upper / down lower / up right / left right / right lower / down	Rate: 1 line (column) per key press All columns in a line moved simultaneously Each line element in a column must be moved individually causing longer movement time	Each time one of these keys is pressed, control of all boundary movement/accept keys is returned. To exit the function both boundary accept keys must be pressed (See next section)
		Boundary Accept Keys		
5 8	Program	-None- Note: do not press these keys simultaneously.	All keys controlling boundary movement and acceptance go out and the program proceeds to display the new area selected	Automatic-both keys must be pressed
		Reject Request		
17	Program	-None-	Transfers control back to program providing an abnormal, instant termination	
		Card Function Keys		
18	Program	-none-	SELECT causes the field information concerning this boundary to be entered at the terminal in field description card format	returns control to the REJECT and card function keys--to exit EDIT FIELD function see key 19 entry
19	Program	-none-	PUNCH is the normal exit to the EDIT FIELD function causing a field description card of	Automatic

			card format	key 19 entry
19	Program	-none-	PUNCH is the normal exit to the EDIT FIELD function causing a field description card of the selected boundary's coordinate to be punched at the program's termination	Automatic
20	Terminal	input any field description information to be entered in any or all of 3 available fields separated by commas. (Example: Corn, TEST1, DeKalb)	The input characters will appear in columns: 10-20 field 1 51-58 field 2 59-80 field 3 on the punched card. The field description card information will appear at the terminal after entry.	returns control to the REJECT and card function keys. Key 19 to normal exit.
		Erase Boundaries		
16	Program	-none-	This causes all boundaries appearing on the screen to be unrecoverably erased	Automatic

TYPE STATUS

This function can be used at anytime when the key is lit to display at the terminal, the coordinates of the area being displayed currently as well as listing the scale of the image and any boundaries presently being displayed.



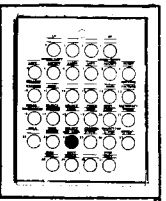
23	Program	-none-	An informational message similar to that produced by ENLARGE, RESTORE, and SELECT appears at the terminal. Note this one lists the last line presently being displayed which the other function does not	Automatic

Table 2-2

*IMAGEDISPLAY Keyboard Functions

SELECT NEW AREA

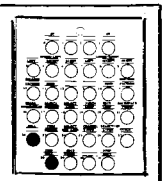
Similar to ENLARGE PICTURE, this allows the user to select a new subset to be displayed using line and - optionally - column coordinates entered at the terminal



24	terminal	Input: initial line, initial column [optional], last column [optional] each separated by commas	Image is redisplayed according to new parameters (see section 2.1.2.2)	Hit carriage return

ROLL

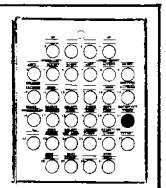
This function causes the data lines being displayed to increase at the rate of 1 line at a time causing an upward rolling of the image.



22	Key 28	-None-	Roll-Initial data line address appearing on the display is increased	Roll will stop automatically if end of data set is reached or when key 28 is pressed
28	Program	-None-	Stop Roll-Function is exited and is stopped after next 4 lines are addressed	

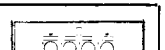
BACKSPACE FRAME

This function is available only after the Roll command has been issued. It causes the image to be redisplayed starting with the original initial line while retaining the same column width. The entire movement is instantaneous.



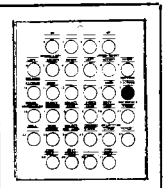
21	Program	-None-	Picture is returned to the initial line where the roll began.	Automatic

RESTORE PICTURE



RESTORE PICTURE

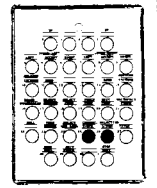
This function is available only after the ENLARGE or SELECT NEW AREA or ROLL commands have been issued. RESTORE PICTURE causes the original scene to be redisplayed. Unlike BACKSPACE frame, the data set is displayed a line at a time and may be a lengthy operation.



15	Program	-None-	The original image is displayed	Automatic

CHANNEL SELECTION

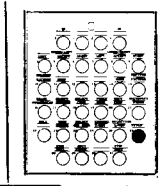
This function (available if more than 1 channel of data was specified in the control card input) permits the user to display any available channel of data overlaying the old channel with the new one. Each line and column coordinate of the new data set appear at the same position on the screen as the old data set. The displaying is done one line at a time.



25	Terminal	input the channel number desired and hit carriage return	New channel of data will be overlayed on the old one	Automatic
26	Lightpen	point lightpen at the desired channel number and press pen against screen	New channel of data will be overlayed on the old one.	Automatic

ENTER TITLE

This function allows the user to input at the bottom of the screen a standard information title line and, if desired, any additional information on any number of lines directly above the first line.



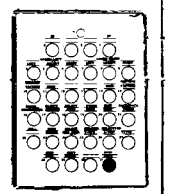
27	Terminal	-None- If you wish to use the input option, the following selections are available.	Automatic title is displayed on screen and input data is requested at the terminal	Enter blank line at terminal (hit carriage return) and type in "exit" when requested
		1) Input desired line	Confirmation requested at terminal: Yes-displays line on screen No-requests input again	
		a) 'YES'	Line of input is displayed	Push key 27 again and enter blank line as above.
		b) 'NO'	Issues request again until you type in 'yes' as indicated above	
		2) Enter blank line	At the terminal you'll	(See 2c)

2d

			type in "exit" when requested
	1) Input desired line	Confirmation requested at terminal: Yes-displays line on screen No-requests input again	
	a) 'YES'	Line of input is displayed	Push key 27 again and enter blank line as above.
	b) 'NO'	Issues request again until you type in 'yes' as indicated above	
	2) Enter blank line (Hit carriage return)	At the terminal you'll be given a choice of typing in: BLANK, RETYPE, or EXIT	(See 2c)
	a) 'BLANK'	a blank line is entered directly above the automatic title shifting any previously entered titles up	
	b) 'RETYPE'	allows you to enter any information as a title following option (1) procedure	
	c) 'EXIT'	returns control to the program	Automatic

STOP EDIT

This function causes normal program termination



31	Program	-none-	Normal program termination. Blanks display screen and enters LARSYS command environment.	Automatic

2.1.2.3 Point Coordinate Status - A new Lightpen Function

This new function, controlled solely through the lightpen, may be requested at any time during the interactive session simply by pressing the lightpen against the screen at a point whose coordinates are desired. This will cause the data set's line and column coordinates to be displayed or typed at the terminal.

This function may be operated at any time when the user has keyboard control. It may not be used in the middle of another lightpen or terminal-controlled function. As with TYPE STATUS, it only momentarily interrupts any previous display operation (such as redisplaying a new image).

2.2 PHOTO

LARS Abstract #649 contains details concerning the operation of this program.

2.2.1 Initialization

The following subsections describe the required input for this program.

2.2.1.1 Program Control Card Deck

The user should set up the input deck according to the control card listing for PHOTO contained in Abstract #649. A copy of that listing appears in Table 2-3. The control cards marked with a '+' are required input. The initial cards should be the user's ID and *PHOTO cards. The user may insert the chosen control cards in any order following these two and before the **end** card. Figure 2-5 shows the proper deck arrangement, while Figure 2-8 gives an example of a PHOTO Deck. The user may abbreviate the data format for the THRESHOLD, LEVELS, and COLORS card as described at the bottom of these cards. If the user finds it necessary to continue the data set beyond this column, then he may place the remainder of the data on a second card using the same format. Figure 2-6 shows the various formats input can take for the THRESHOLD, LEVELS, or COLORS cards.

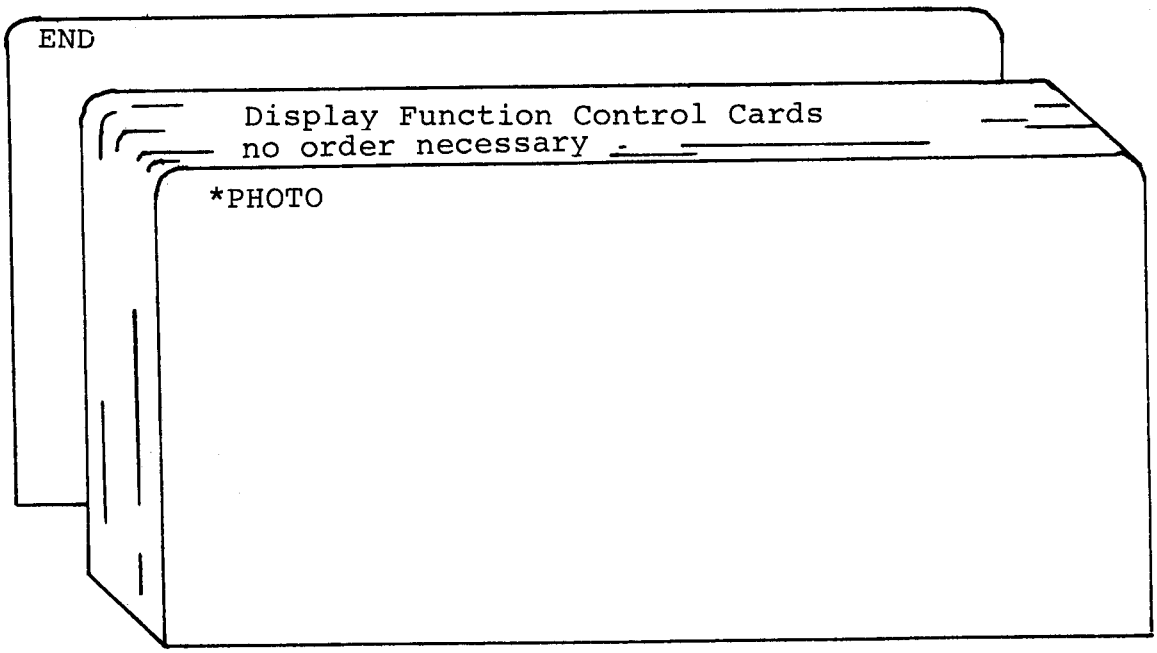
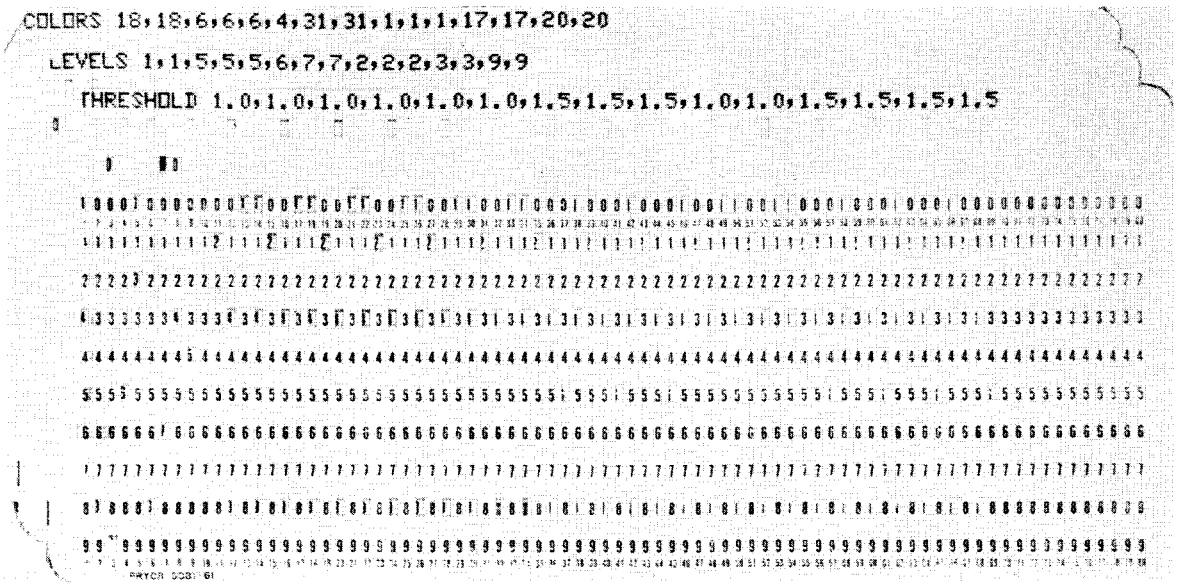


Figure 2-5

The Ordering of a PHOTO Program Deck

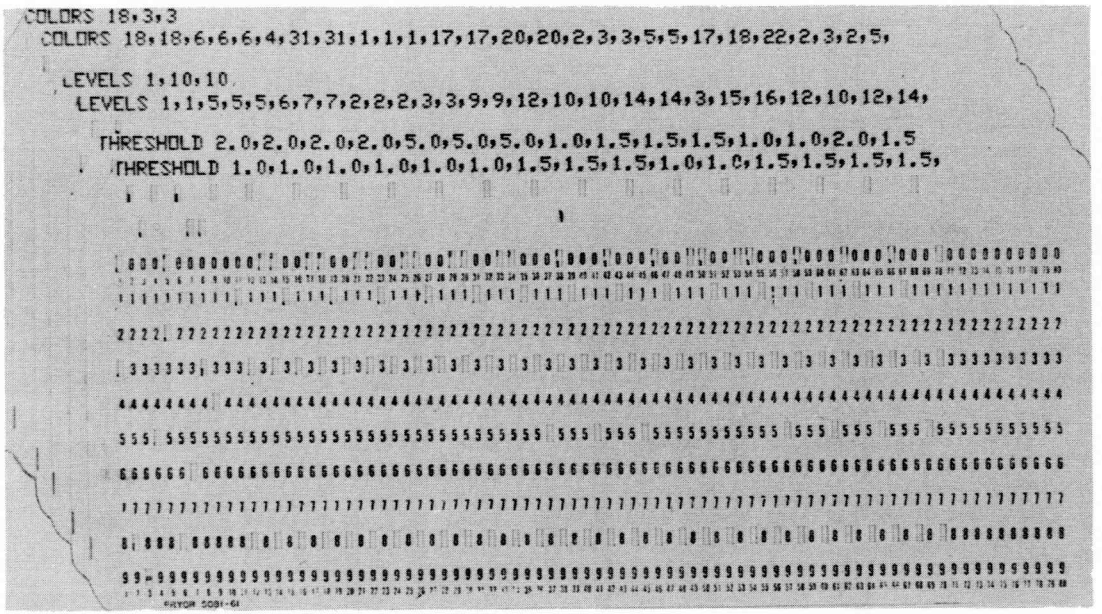
Figure 2-6
Data Card Format For the
THRESHOLD, LEVELS and COLORS Cards

NORMAL LENGTH
(all data fits on one card)

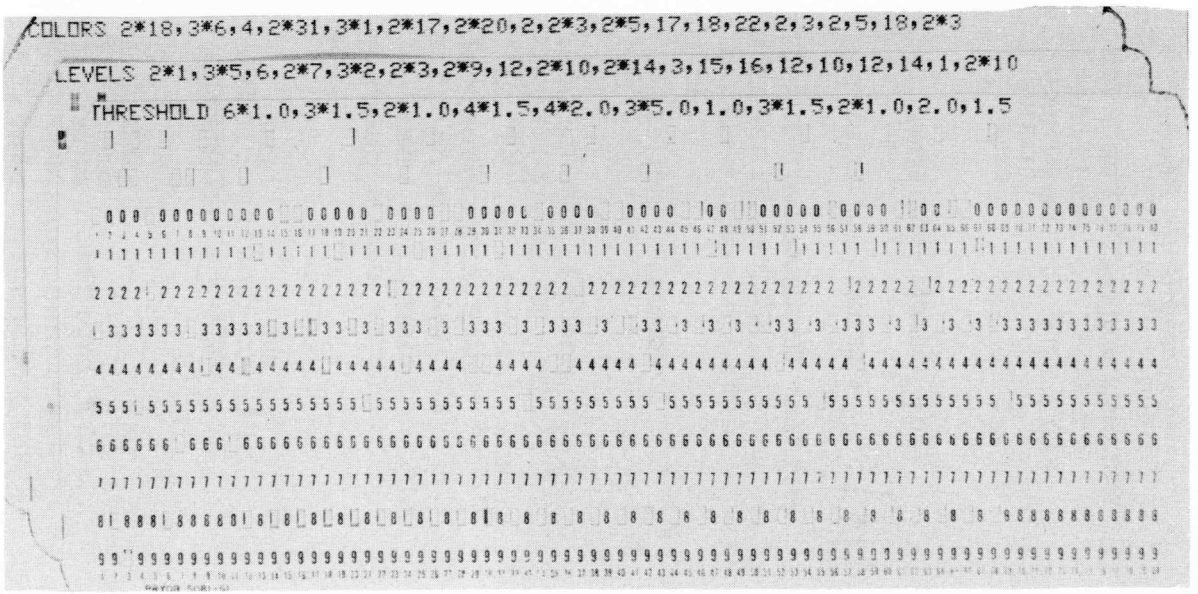


LONGER LENGTH
(data requires more than 72 cols)

extended



abbreviated



REQ	KEY WORD(COL.1)	CONTROL PARAMETER	FUNCTION	DEFAULT
+	*PHOTO	(NONE)	SELECT CLASSIFICATION RESULTS DISPLAY FUNCTION.	(NONE)
+	RESULTS		LOCATION OF RESULTS TO BE DISPLAYED.	(NONE)
		TAPE(XXX)	LOCATED ON TAPE XXX.	
		FILE(FF)	FILE FF.	
		DISK	USE RESULTS PLACED ON DISK BY CLASSIFYPOINTS IN CURRENT TERMINAL SESSION.	
	PRINT	STATS	PRINT SAVED STATISTICS.	NO STATISTICS PRINTED
+	LEVELS	L1,L2,...	ASSIGN THESE LEVELS TO CLASSES.	(NONE)
	THRESHOLD	T1,T2,...	USE THESE THRESHOLDS FOR CLASSES 1,2,...(SEE NOTE BELOW) THRESHOLDS MUST BE POSITIVE AND ONE VALUE MUST BE SPECIFIED FOR EACH CLASS.	THRESHOLDING NOT USED
	COLORS	C1,C2,...	USE THESE COLORS FOR CLASSES 1,2,... IN THE COLOR PICTURE.	(NONE)
	BLOCK			ENTIRE AREA
		RUN(XXXXXXXX)	DISPLAY ONLY RUN XXXXXXXX---I	
		LINES(X,Y,Z)	DISPLAY ONLY LINES X TO Y I WITH LINE INTERVAL Z I	(NONE)
		COL(X,Y,Z)	DISPLAY ONLY COLUMNS X TO Y I WITH COLUMN INTERVAL Z----I	
	CAMERA	35MM	PICTURES WILL BE TAKEN USING 35MM CAMERA OPERATED IN AUTOMATIC MODE. (USER DOES NOT NEED TO TRIP SHUTTER OR ADVANCE FILM)	PICTURES WILL BE TAKEN WITH POLARIOD OR 35MM CAMERA IN MANUAL MODE. (USER AND ADVANCE FILM)
+	END	(NONE)	END OF FUNCTION.	(NONE)

NOTE.....THRESHOLD VALUES MAY ALSO BE SPECIFIED IN THE FOLLOWING FORMAT....

N1*T1,N2*T2,...

WHERE N1 AND N2 ARE INTEGERS WHICH SPECIFY HOW MANY CONSECUTIVE TIMES THE CORRESPONDING THRESHOLDS SHOULD BE USED AND T1 AND T2 ARE DECIMAL NUMBERS WHICH DESIGNATE THE PERCENTAGE OF POINTS THAT ARE EXPECTED TO BE THRESHOLDED

THUS, 2*7.5, 3*2.9, 1.5
HAS THE SAME EFFECT AS 7.5,7.5,2.9,2.9,2.9,1.5

Table 2-3
PHOTO Control Card Listing

The following is a brief discussion concerning the usage of each control card:

RESULTS TAPE (xxx)
FILE (ff)
DISK

The user must include this card in order to specify the location of the results to be displayed. If he recorded the results on tape, then both the TAPE and FILE parameters must appear on this card. If the classification results are still on the disk, then the program requires the DISK option.

PRINT STATS

Using this card causes the program to have the means and covariances for each class printed.

The next three control cards required a set of numerical values- one value for each of the classes in the classification. The user must list these values in the same order as the classes are specified in the classification results.

LEVELS L1, L2, . . .

This card must be part of the input deck even if the user does not desire a grayscale image. The values L1, L2, . . . assign a graylevel from 1 (darkest) to 16 (brightest) for each of the classes. If the user desires a grayscale for the thresholded points, he may specify this as the last value following all of the classes. If he does not include the LEVELS card, the program will request a set at the terminal before proceeding.

THRESHOLD T1, T2, . . .

This card should appear only if threshold values are desired for any of the classes. The user must specify one value for every class of the data.

COLORS C1, C2, . . .

This card specifies the colors - using the numerical code on COLRCHRT images (see section 2.3) - to represent each class. It uses the same format as LEVELS. Depending on the color number selected for each class, the program represents each data point in each class with the appropriate sequence of 3 grayscales for each class displayed in the color image sequence during the interactive session.

BLOCK RUN (kkkkkkkk), LINE (x,y,z), COL (x,y,z)

If displaying only a subset of the entire classified area, the user should include this card to request the appropriate area. He must specify the area according to the original run number and the desired lines and columns in the standard format (as specified in the control card listing). The program will ignore the last line chosen during the terminal session if the user issues the 'SELECT LINE' or 'ROLL' command.

CAMERA 35mm

This command allows the user to operate the 35mm camera in the remote mode. This automatically operates the shutter the required number of times when the complete data set appears on the screen for each of the 3 channels. The film then advances automatically when the image is complete. If the user wishes to operate either the 35mm locally in the usual manner or the polaroid for color images, then he should omit this card. for details concerning camera operation see Part II of this guide.

NOTE: If the user includes this card, he can not easily operate the polaroid camera for pictures during the program.

2.2.1.2 Classification Results Input

The PHOTO program displays LARSYS classification results. The program will accept these results via one of two ways. If the user generated these results during the present terminal session, the program will read them directly from the disk. If the disk does not already contain the results, then the program must obtain them from a LARS 'results' data tape. The user must specify the the form of input and its location (if on tape) on the RESULTS card in the PHOTO control card deck. During the interactive session, the program reads the data directly from the input device. Obviously, data read from the disk will be more quickly available than the data tape results. The present PHOTO program does not have the capability of loading data tape information onto a disk as in IMAGEDISPLAY.

2.2.1.3 The Terminal

The PHOTO program operates only in an interactive mode. Login and LARSYS initialization procedures are the same for PHOTO as for other LARSYS functions with the following exception: instead of entering'RUN LARSYS' at the terminal to begin execution the user must type 'RUN PHOTO'. Figure 2-7 gives

a sample of the initialization procedure.

```
T=0.70/0.91 15.23.55
run photo
EXECUTION BEGINS...

 PHOTO-1004  PHOTO FUNCTION REQUESTED     (PHOSUB)
 10002  TAPE     0391 HAS BEEN REQUESTED ON UNIT 0180  (MOUNT)

DEV  180 ATTACHED
 10003  TAPE READY...EXECUTION CONTINUING     (MOUNT)
 10042  POSITIONING RESULTS TAPE  391 TO FILE   1     (INITAPE)
 10045  RESULTS TAPE MOUNTED AND POSITIONED     (INITAPE)
 PHOTO-1010  ALL CONTROL AND DATA CARDS HAVE BEEN READ     (PHOINT)
 PHOTO-1011  AFTER 'DEV 2A0 ATTACHED' MESSAGE IS TYPED, PUSH FUNCTION KEY 30 TO CONTINUE     (PHOTO)
DEV  2A0 ATTACHED
```

By pushing function key 30 at this point, the program will resume entering the interactive phase. This is indicated by the terminal message:

```
 PHOTO-1012  PHOTO FUNCTION CONTINUES..     (PHOTO)
```

Figure 2-7

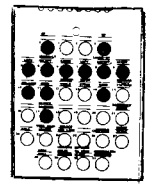
PHOTO - The Initialization Phase

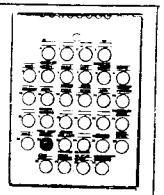
After the operator mounts the tape and the program locates the desired run (if using tape) the message to attach the display will appear at the terminal. After the computer operator sends a message confirming the display link, the user presses function key 30 to continue. Figure 2-7 shows the format of the messages.

2.2.2 Interaction

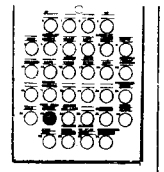
The interaction procedures consist of input by the display operator via the terminal, lightpen, or display keyboard (see Figure 2-4). Once the operator attaches the display, the user handles the display through the keyboard. He enters input at the terminal or via the lightpen only after pressing a keyboard function key activating one of these two devices.

The functions controlled through PHOTO are discussed fully in the PHOTO Manual, LARSYS Abstract #649. Table 2-4 contains

Press Function Key #	Controlling Device	User Action	Response	Function Exit
ENLARGE PICTURE This allows user to visually select a subset of the displayed image to be enlarged using the lightpen				
10	lightpen	Input 4 points defining the rectangular area to be enlarged.	A rectangular boundary will be drawn	Transferred to boundary movement keys
		Boundary Movement Keys		
0 4 6 11 3 7 9 14	Simultaneous control of all 8 function keys as well as boundary accept keys	When pressing any of these keys the following response occurs on the screens: boundary moved / direction upper / up left / left left / right upper / down lower / up right / left right / right lower / down	Rate: 1 line (column) per key press All columns in a line moved simultaneously Each line element in a column must be moved individually causing longer movement time	Each time one of these keys is pressed, control of all boundary movement/accept keys is returned. To exit the function both boundary accept keys must be pressed (See next section)
		Boundary Accept Keys		
5 8	Program	-None- Note: do not press these keys simultaneously.	All keys controlling boundary movement and acceptance go out and the program proceeds to display the new area selected	Automatic-both keys must be pressed
		Reject Request		
17	Program	-None-	Transfers control back to program providing an abnormal, instant termination	

TYPE STATUS This function can be used at anytime when the key is lit to display at the terminal, the coordinates of the area being displayed currently as well as listing the scale of the image and any boundaries presently being displayed.				
23	Program	-none-	An informational message similar to that produced	

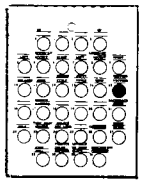
TYPE STATUS



This function can be used at anytime when the key is lit to display at the terminal, the coordinates of the area being displayed currently as well as listing the scale of the image and any boundaries presently being displayed.

23	Program	-none-	An informational message similar to that produced by ENLARGE, RESTORE, and SELECT appears at the terminal. Note this one lists the last line presently being displayed which the other function does not.	**Automatic**

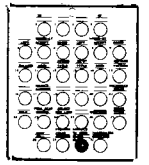
RESTORE PICTURE



This function is available only after the ENLARGE command has been issued. RESTORE PICTURE causes the original scene to be redisplayed. Unlike BACKSPACE frame, the data set is displayed a line at a time and may be a **lengthy operation.**

15	Program	-none-	The original image is displayed	Automatic

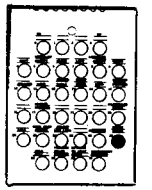
ADVANCE TO NEXT BLOCK



This function allows the user to display additional predefined subsets of the original classification as specified in additional BLOCK control cards

30	Program	-none-	Advances the tape to the next classification block in line and displays the data on the screen	Automatic

ENTER TITLE



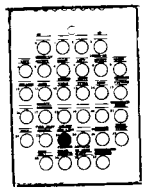
This function allows the user to input at the bottom of the screen any number of informational title lines. Each time the function key is pressed, one title line can be typed and transferred to the bottom of the screen. Any preceeding lines are shifted upward.

27	Terminal	Input desired line of information and hit carriage return	**The title is automatically displayed at the bottom of the screen. If additional title lines are requested, the former lines are shifted upward**	Key 26--all keyboard control returned and title erased if it overlays any data. Key 29- Title will be retained through the picture taking sequence.

Table 2-4

*PHOTO Keyboard Functions

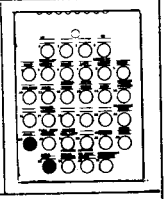
SELECT NEW LINE



This function allows the user to select a new subset to be displayed using a new initial line entered at the terminal. The initial and final columns remain the same, while the final line is adjusted according to the amount of data displayed after selecting the new initial line.

24	Terminal	Input: initial line and hit carriage return	Image is redisplayed according to the new parameters	Automatic

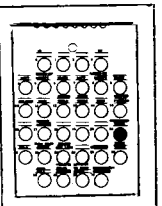
ROLL



This function causes the data lines being displayed to increase at the rate of 1 line at a time, causing an upward rolling of the image. When used in *PHOTO, this command gives access to any data for this particular set of results beyond the subset specified in the control cards.

22	Key 28	-none-	Roll initial data line address appearing on the display is increased	Roll will stop automatically if end of data set is reached or when key 28 is pressed
28	Program	-none	Stop Roll-Function is exited and is stopped after next 4 lines are addressed	

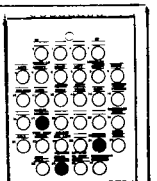
BACKSPACE FRAME



This function is available only after the ROLL or SELECT NEW LINE commands have been issued. It causes the image to be redisplayed starting with the original initial line while retaining the same column width. The entire movement is instantaneous.

21	Program	-none-	Picture is returned to the initial line where the roll began	Automatic

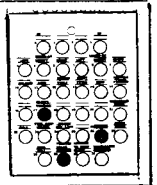
PRODUCE COLOR PICTURE



This function causes a sequence of three graylevel images to be displayed for photographing through the three color filters to produce a color image with color coded classes as specified on the COLORS card

			initial line where the roll began	

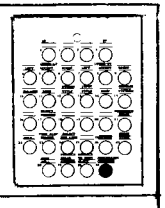
PRODUCE COLOR PICTURE



This function causes a sequence of three graylevel images to be displayed for photographing through the three color filters to produce a color image with color coded classes as specified on the COLORS card

29	Program	-none-	First image is displayed. Camera information appears at the terminal	Press key 26 to continue or 17 to reject the function
			Continue Key	
26	Program	When the full image is displayed, the photographic exposure should be made before pressing this key. If the 35mm remote option was specified, then push key 26 as soon as the image is ready to photograph and the shutter will operate automatically	This key is operable only after key 29 has been pressed. The photographic exposure should be made before pressing it. Key 26 causes the next sequential image to be displayed. After the third image has been displayed, pressing this key restores the original grayscale image and exits this function.	Press key 17 to abnormally terminate the function
			Reject Picture Key	
17	Program	-none-	**The picture function is exited and keyboard control returned**	**Automatic**

PROCESSING COMPLETE



This function causes termination of the program. If additional subsets were requested in BLOCK cards, these will be read and displayed each in sequence when this key is pressed.

31	Program	-none-	Next image is displayed (if any). If none, then the program is terminated	Automatic

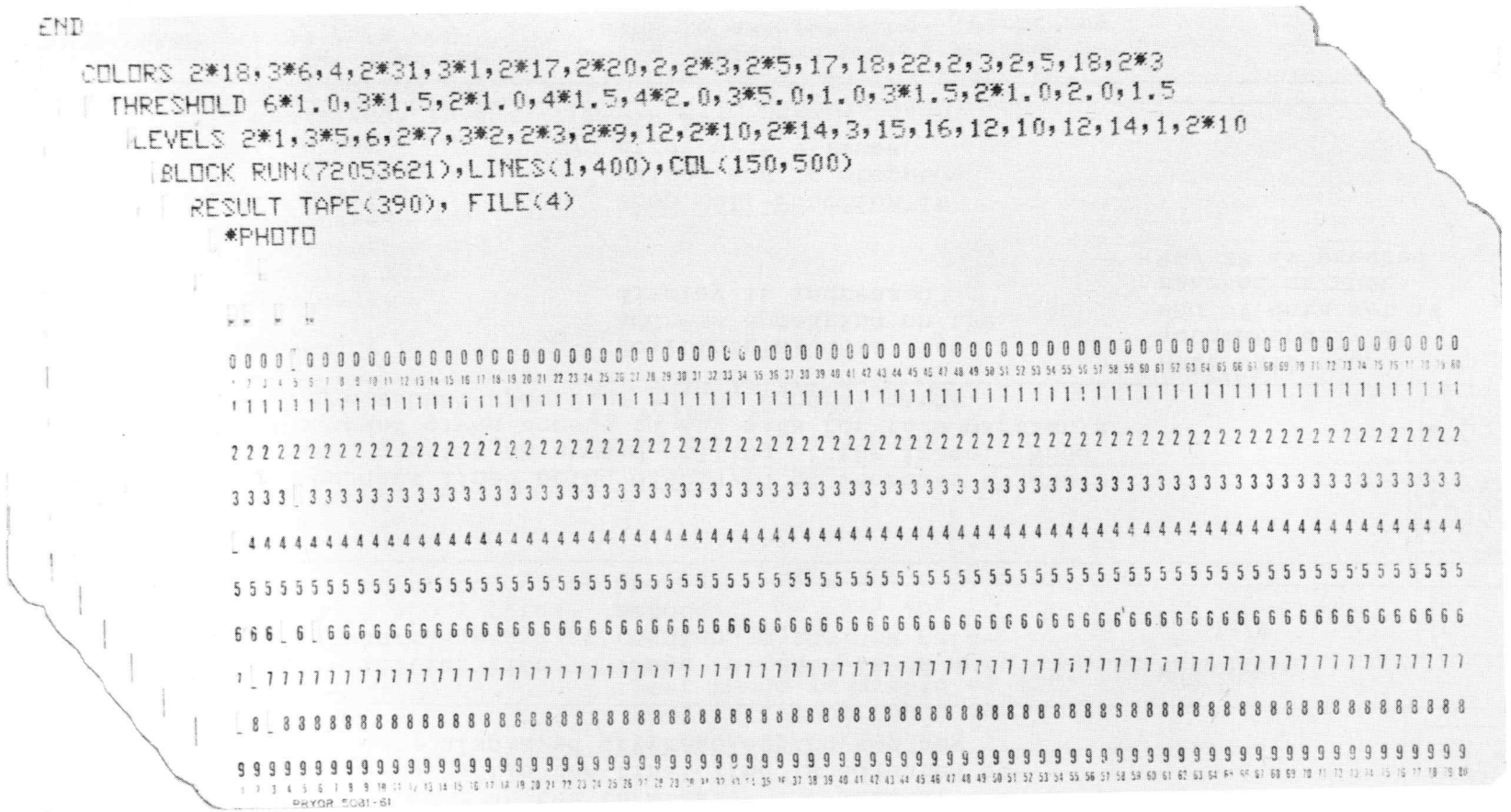


Figure 2-8

An Example of a PHOTO DECK

a brief description of each of the function keys used in PHOTO. Figure 1-2 shows a copy of the keyboard overlay used for the PHOTO program.

2.3 COLRCHRT

This section discusses the third and final digital display controlling program available under LARSYS. This program produces the coded and dated color chart used to select classification colors. It may also serve as a test pattern to check color consistency over a period of time.

2.3.1 Initialization

The only input device needed for this program is the terminal. There are no data cards for input and no data tape. The only form of output is to the digital display.

To begin the program, the user issues the standard login and LARSYS initialization procedure. As in the case of the PHOTO program, the function name itself accesses COLRCHRT. The user accomplishes this by typing 'run colrchrt' at the terminal after entering the LARSYS environment. Figure 2-9 shows a sample terminal session for the COLRCHRT program.

The program begins by attaching the digital display if it is not already attached. At this point the interactive portion of the terminal session begins.

2.3.2 Interaction

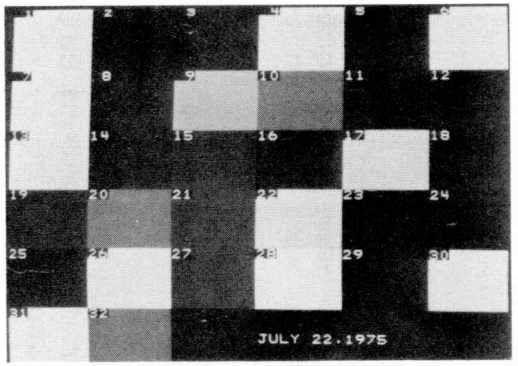
Once the interactive part of the program begins, the program writes on the screen the first grayscale image required to produce COLRCHRT. This will include the present date for convenient future reference. Informational messages will appear at the terminal directing the user to insert the proper filter and to push function key 30 after photographing the grayscale image.

When the user has photographed the first grayscale, pressing function key 30 will display the second grayscale image on the screen. The same procedure will apply for the third and final image. After photographing all three grayscales through the appropriate filters, the image is complete and should be handled in the usual manner for color display imagery. (See part II of this guide). Pressing function key 30 a final time will terminate the program.

For more details concerning the COLRCHRT program see LARS Abstract #664.

```
T=1.88/2.70 11.14.33
run colrchrt
 THE FOLLOWING NAMES ARE UNDEFINED:
      LRGCHR   HDSKIN   HDSKOT
EXECUTION BEGINS...
 10100 AFTER "DEV 2A0 ATTACHED" MESSAGE IS TYPED, PUSH FUNCTION KEY 30 TO CONTINUE   (COLRCHRT)
DEV 2A0 ATTACHED
```

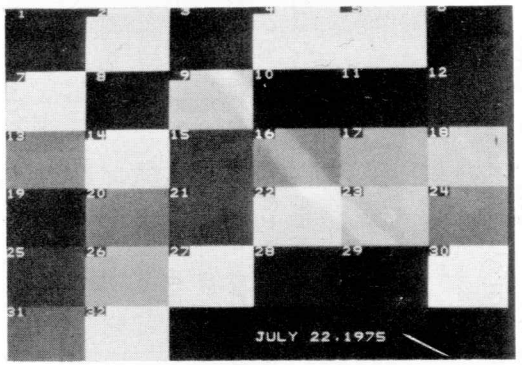
press function key 30 on the display keyboard




```
 10200 COLRCHRT FUNCTION CONTINUES..    (COLRCHRT)
10300 INSERT BLUE FILTER      (COLRCHRT)
10400 PUSH FUNCTION KEY 30 WHEN FINISHED    (COLRCHRT)
```

press function key 30 again

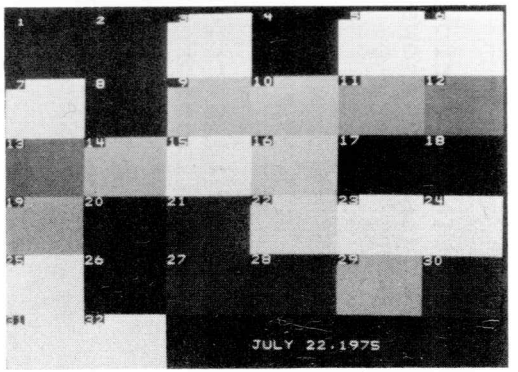
```
10300 INSERT GREEN FILTER     (COLRCHRT)
10400 PUSH FUNCTION KEY 30 WHEN FINISHED    (COLRCHRT)
```



press function key 30 again

```
10300 INSERT  RED  FILTER     (COLRCHRT)
10500 ADVANCE OR PROCESS FILM WHEN IMAGE IS COMPLETE   (COLRCHRT)
10400 PUSH FUNCTION KEY 30 WHEN FINISHED    (COLRCHRT)
```

press key 30 to blank screen and terminate program




```
10600 COLRCHRT FUNCTION COMPLETED     (COLRCHRT)
T=42.15/55.17 11.18.29
```

Figure 2-9
Operation of the COLRCHRT Program

3.0 Operating the Digital Display

This section discusses the operating environment of the digital display: the controls that are available to the user and their proper handling, system limitations, and common problems which the user may encounter. Figure 3-1 shows the location of each of the pieces of hardware discussed here.

The following details should give the digital display user a better feel for the equipment at his disposal and its proper usage.

3.1 The Power Control Units

This section describes the power controls for both the large screen display console (DC) and the smaller photocopy unit (PCU).

3.1.1 The Display Console (DC)

The "interface power on" lamp shown in Figure 3-1 is back-lighted when power is on at the console control unit. This should be the case whenever the system is operational. With the interface power on, pushing the "monitor power-on" button establishes power to the display console. This button is back-lighted when the monitor power comes on. It should take no more than 30 seconds for the screen to brighten. There may be either data or a blank screen of a lighter gray level apparent when the power comes on. It takes at least 30 seconds longer for the image to completely fill the screen and stabilize.

Pushing the "monitor power-on" button will shut off power to the display console thus blanking the screen. This should not effect a user's program even during the middle of a terminal session. However, the power should usually be left on. The display console will then power on or off with the computer system.

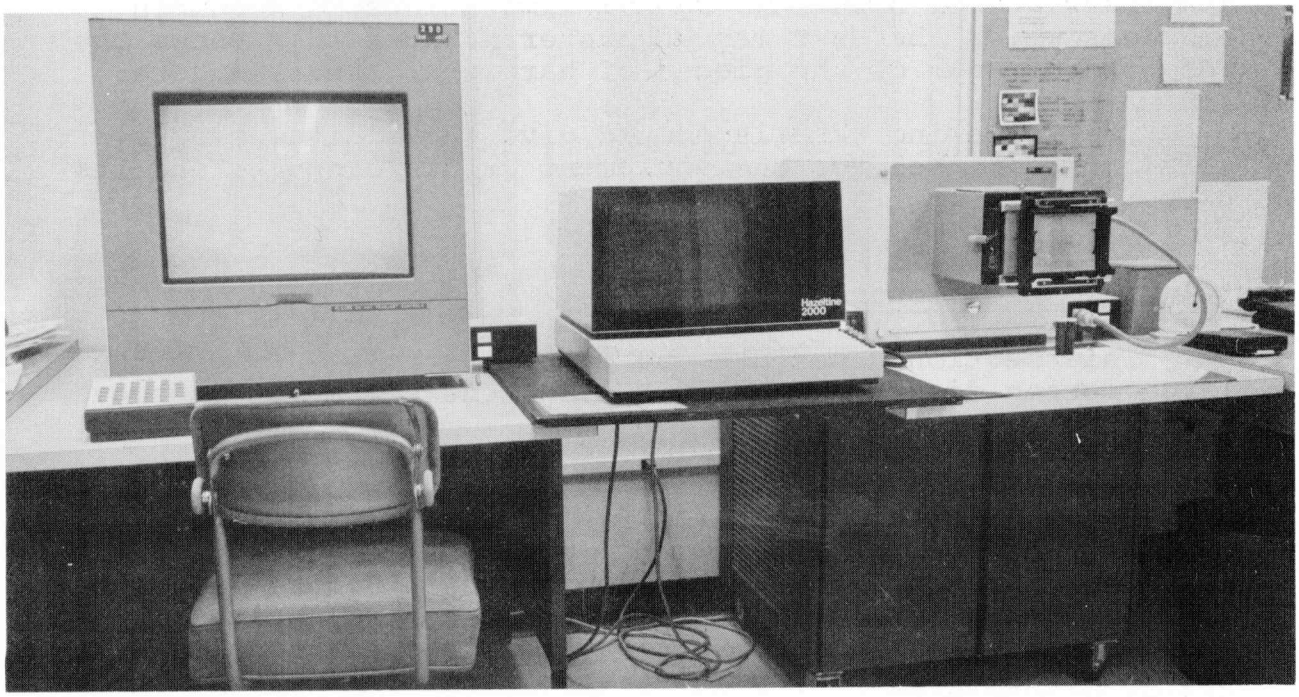
3.1.2 The Photocopy Unit (PCU)

As with the DC, the PCU "interface power-on" lamp lights up when power is on at the console control unit. With this power established, pushing the "monitor power-on" button turns power on to the PCU. This button is also the "push to operate - push to release" kind as is the DC's control. The warmup period involved is the same as for the DC. Before taking any imagery,

Digital Display
Console (DC)

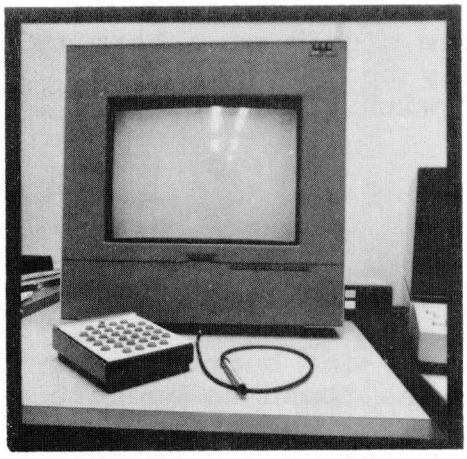
Hazeltine

Photocopy
Unit (PCU)



Digital Display Console (DC)

Photocopy Unit (PCU)



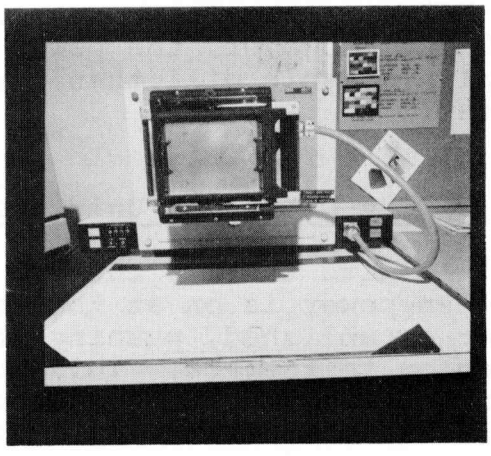


Figure 3-1
The Digital Display System

it is a good precaution to wait at least two minutes to fully establish the image on the screen. The power may be shut off and turned on at any time without effecting the data to be displayed.

The cable provided connects the camera plug on the power control box to either camera. This cable provides the electrical controls for the camera shutter (both units) and film advance (35mm only) functions and should remain connected to the power control box.

3.2 Display Controls

The user controls the digital display directly via the terminal, function keyboard, and the lightpen. Screen image controls are also available but not for general use. The following sections discuss each of these controls briefly.

3.2.1 Screen Image Controls

The brightness, contrast, and image displacement controls for both units are located below the screen. The user should never need to adjust these controls. If for any reason the image requires adjustment, the user should contact the pictorial interface supervisor or the computer operations supervisor. If he cannot reach either of these persons, a computer operator can probably help in making some adjustments to the main screen. However, any adjustments to the photocopy unit must be made only by IBM or one of the two supervisors.

This rule is for the user's benefit. Standard screen image sizes have been set as well as colors and grayscale levels. Any tampering with the controls will upset these values. The display console image grayscales are set so that all 16 shades are discernible. Any change in contrast or brightness would disrupt this balance.

If at the proper screen brightness the user experiences any difficulty in locating features, he may turn off the lights over the display area. Looking at the image through the photocopy unit will sometimes help to locate features not easily seen on the large screen.

On the photocopy unit, the admonition is even stronger. Any change in contrast or brightness will probably result in a change in the color levels for color digital imagery. Resetting these colors is an involved operation which may take several hours. Therefore, please refer any image problems to the appropriate people.

3.2.2 The Display Function Keyboard

In order to properly operate the display function keyboard, the overlay for the appropriate program must be placed over the function lights. The overlays used for the standard programs are in the drawer to the left of the display console. Generally, the IMAGEDISPLAY overlay should be on the keyboard. To place an overlay on the keyboard, slide the upper edge of the overlay into the slot at the top of the keyboard. Then place it over the buttons and the raised metal disk near the top of the keyboard. Be certain the overlay is laying flat, securely in position.

The user should observe the following cautions when using the function keyboard:

1. In general, any backlit key is functional and may be pressed to issue a command to the display.
2. Do not press the function terminating key (usually function key 31) until ready to end the program.
3. Do not hit keys in rapid succession. Always try to wait for the proper response to a keyboard interrupt before pressing another key. Too rapid a succession of requests can cause the display to "hang-up" (See section 3.4).

When all the lights are out on the keyboard, then one of the following is probably the reason:

1. Control has been transferred to the lightpen or terminal.
2. The power has been shut off (check the display console power control buttons).
3. The display is "hung-up" and must be reset by the operator.

3.2.3 Using the Lightpen

The lightpen's main functions are to select channels, define boundaries for the purposes of editing fields or enlarging the image and to determine point coordinates. For the standard programs, the user must access two functions through the function keyboard. The point coordinate status can be the first obtained at any time during the interactive session by pressing the lightpen against the screen at a desired point.

The lightpen operates by pressing it firmly but gently against the screen at the position where the input is to be sensed (i.e. if channel 1 is to be selected, the lightpen should be pointed at the figure "1" on the screen and pressed). Channel selection and coordinate status do not cause a point to actually be displayed on the screen. However, in the case of

boundary outlining, a cursor (a 4x4 picture element square) appears in a grayscale contrasting with the date on the screen at that spot. Placing 4 points on the screen will cause a horizontal/vertical-aligned rectanglar boundary to be drawn. This boundary will be the minimum possible rectangle defined by the 4 points inputted. That is, the second lowest point determines the upper boundary, the second point from the left determines the left-hand boundary, etc. To place a point at a precise loaction on the screen, line up the two beams of light from the lightpen so that they surround the desired point. Then press the pen against the screen holding it perpendicular to the face of the screen.

The program has accepted a lightpen command if a brightening of the scan line across the screen appears corresponding to the line in which the selected point is located. There may be a delay up to a minute for the point to appear (depending upon the system's response time). However, the scan line brightening should be instantaneous.

If the lightpen is not functioning when the user presses it against the screen, then one of the following is probably the case:

1. Display control has been transferred to either the keyboard (if any lights besides REJECT REQUEST are lit) or the terminal (if input is being requested).
2. The display is 'hung up' and either the pictorial interface, computer operations supervisors or the senior operator must reset it.
3. The lightpen is malfunctioning. If this is the case, first ask the senior operator to check out the problem. If necessary, contact (or have computer operator contact) one of the two aforementioned supervisors immediately.

3.2.4 Using the Hazeltine 2000 Terminal

Although the display can be controlled from any terminal (practically speaking, only those in the proximity of the digital display area) the standard display terminal is the Hazeltine 2000. However, an IBM 2741 is also located in the display area to serve as an alternate terminal.

The Hazeltine, a cathode ray tube display, is a recently introduced terminal for general usage. A terminal session on it is conducted in the same manner as with the 2741. General instructions applying to the Hazeltine 2000 are posted on the table next to the unit itself. The digital display reservation

sheet - located on the table to the left of the display console- automatically reserves the Hazeltine as well as the display.

The Hazeltine 2000 is particularly useful in conjunction with the digital display programs. It reduces the amount of time necessary to exit some functions by displaying almost instantly a line of data on its screen. The only main drawback to its use is the lack of hardcopy output for the terminal session. Once the data has left the screen, it cannot be recalled. However, in the majority of cases where terminal output is not essential, the Hazeltine 2000 proves to be most useful and efficient.

3.3 System Limitations

This section discusses the main limitations of the digital display system. Some apply to the system in general while others apply only to the display console (DC) or the photocopy unit (PCU). The devices will be indicated by their abbreviations in the following sections.

3.3.1 Image Distortion

When the digitized data is displayed on the screen, each data point appears as a square picture element. This introduces a distortion. In the case of LANDSAT data, for example, where a data sample represents 56 meters horizontally and 79 vertically, a vertical data compression occurs. The data can be reformatted, however, which can remove this distortion for the digital display. If a data set has been corrected for the line printer it may easily be adjusted to the proper display dimensions using one of two programs available through the pictorial interface supervisor.

Both the PCU and the DC will experience some variation across the screen in standard pixel dimensions. Generally, a pixel will expand in length as it approaches the edge of the screen. The standard pixel size is determined from adjustments using the center of the screens.

In addition to the above distortion, the following apply to the DC:

- Horizontal data compression is present along the right edge of the screen.
- Approximately the top 10 lines of data are not generally displayed on the screen.
- Some scattered variance in pixel size not covered in the above points will occur from time to time. The most common is a data expansion in the upper left corner of the screen.

The following is a list of distortions affecting the PCU and, therefore, any imagery produced from it. Figure 3-2 shows a grid with white lines spaced at every tenth data point. This gives a good example of the types of data distortion present for any given image.

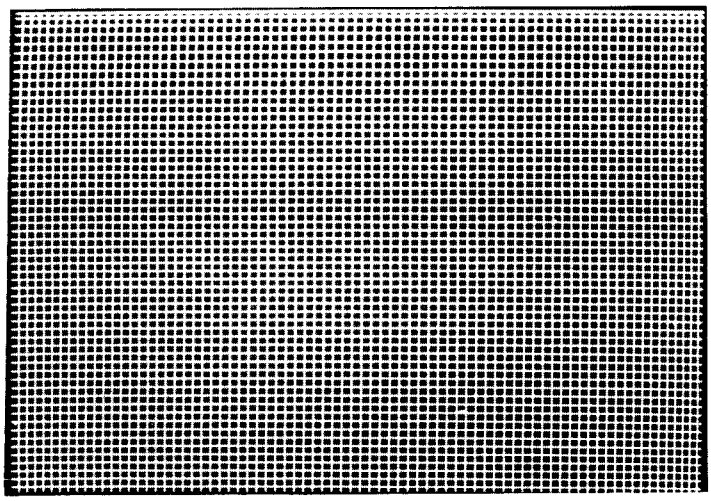


Figure 3-2

The Digital Display Test Grid

- Extreme data compression of the top 10 lines is present with a gradually decreasing compression through the next 90 lines.
- A blossoming effect or image curvature (barrel distortion) is most noticeable on the left side of the image, gradually decreasing towards the right side.
- A horizontal line grayscale variation producing a vertical "ripple effect" can be seen down the left edge of certain images.
- There is a slight data compression affecting the bottom 60 lines.

3.3.2 Focus

Another problem inherent in the system is the inability to obtain a sharp focus across either screen for the entire image. Figure 3-3 gives a sample of the focus problem as photographed using the PCU. The image is a dark background with regularly spaced points of light over the entire screen.

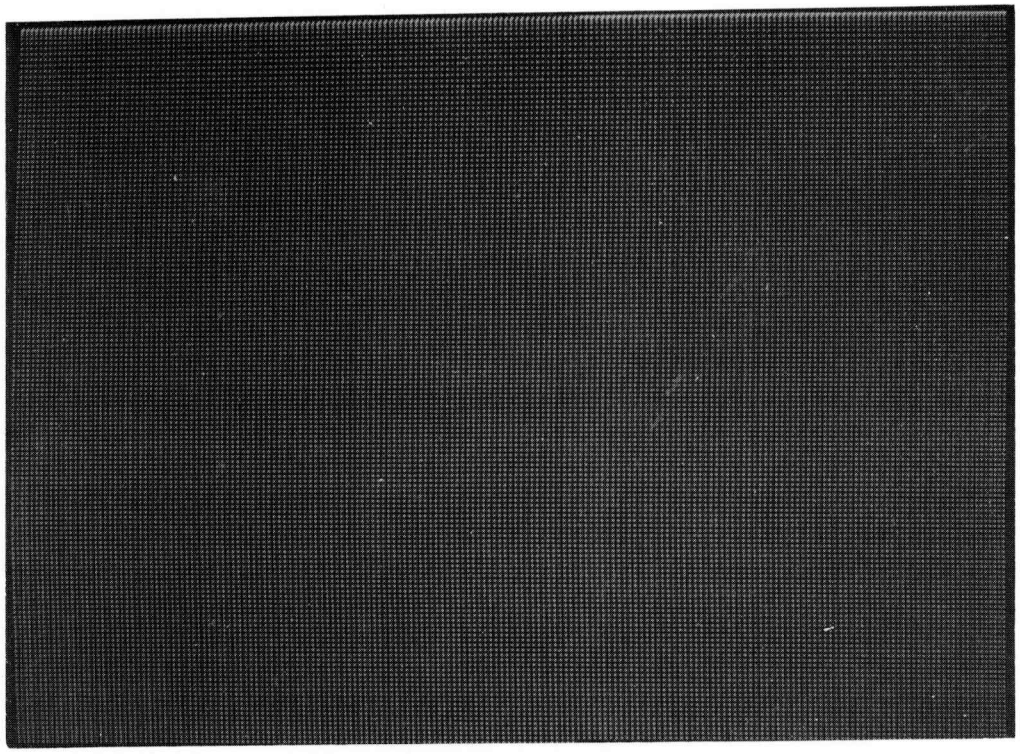


Figure 3-3

The Display Resolution Pattern

The areas of data compression and distortion show an exceptional loss of focus. The center of the image corresponds closely to the center of focus. A gradual degradation occurs as the image approaches the edge of the screen.

3.3.3 Grayscale Variance

One of the major problems in dealing with grayscale images on the digital display is that a given gray level (for example, level 10) does not possess a precise radiance value. In other words, the brightness of a given point with a gray level of 10 actually depends on the surrounding data. The reason for this is, the display monitors maintain a constant average brightness level no matter what type of data is being displayed on the screen. Therefore, for each different scene, an appropriate radiance value for each gray level will be calculated.

The problem of grayscale variance is an involved one where several factors may account for various distortions. In some cases the user can bypass these distortions by selecting different colors or levels. In general, the following factors most effect the consistency of a gray level and the size of the point itself:

SCENE DEPENDENCY - The actual value of a grayscale may vary from one scene to the next depending on the balance of the amount of light-to-dark areas for all the data points in a scene.

BACKGROUND LEVEL - If greater than approximately 65% of the data consists of only one gray level, then several distortion problems become apparent. Most noticeable is an inconsistency in radiance across the screen for the background level itself. Distortion of the individual data points becomes more pronounced. The extreme effects of such an imbalance can especially be seen in the colors represented on the image. (See Section 3.3.4 - Color Quality for more details.)

EXCESSIVE CONTRAST - If there is too much contrast between adjacent points, a blossoming effect occurs where the boundary between the two shades will no longer be sharp. The lighter point (or group of points) increases in size cutting off part of the dark area. The user can bypass this problem most easily by using levels closer to each other in contrast. If the problem persists, or if this solution is not feasible, contact the pictorial interface supervisor.

3.3.4 Color Quality

The problems of grayscale variance are compounded when producing a color image using the 3 filter-channel combinations. The following discussion concerns some of the problems and their causes.

VARIANCE IN COLORS - Since the actual brightness of the gray levels themselves may vary for different scenes or channels, the colors as represented on the color chart will not necessarily be consistent for each scene. If an extreme imbalance in gray levels exits (i.e. 65% or more of the data equaling one level - Figure 3-4 shows such an image), then there is no guarantee that the colors in the scene (especially the background) will be the same shade as expected. This problem appears most frequently in classification results where a certain color represents a large class or group of classes. For assistance in dealing with such a problem, please see the pictorial interface supervisor.

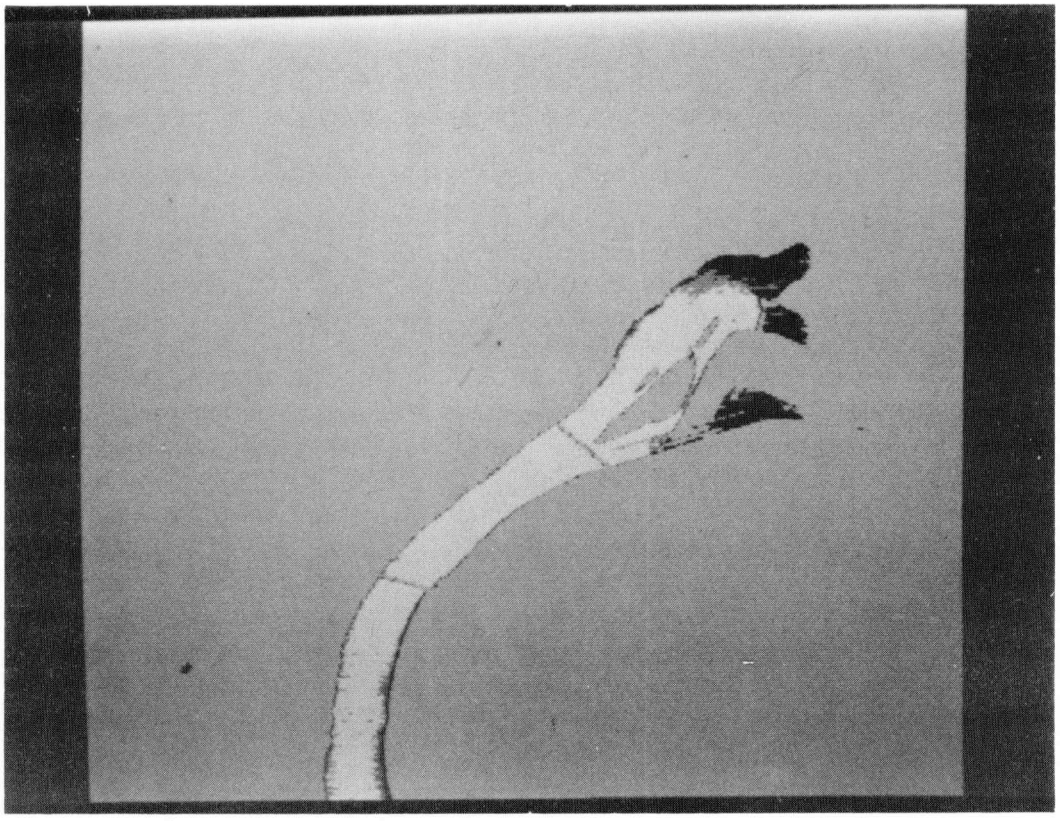


Figure 3-4

Extreme Gray Level Imbalance

COLOR REGISTRATION - Since the grayscale problem of change in point size is also present, there are likely to be indistinct boundaries between points when the user performs a three channel-filter overlay (a color image) on each point. This registration problem is likely to affect the sharpness and clarity of the color image for each point or group of points although in many cases the problem is not too noticeable. The problem becomes greater the more grayscale variance that is apparent within each channel. For assistance in selecting colors to minimize this edge effect, contact the pictorial interface supervisor.

3.3.5 Slow System Response

If there are many users on the system, or if the data is being handled from tape, control and response of the digital display may be very slow and frustrating.

With a heavily loaded system, those functions usually accomploshed almost instantaneously (i.e.; lightpen response, roll, displaying data on the screen-even from the disk, title display, etc.) may take more than a minute from the time the

command is entered to the time the system responds. If this should be the case, patience becomes the most important factor in keeping the program operating properly. If the user enters more than one command (for example, two or more keyboard functions pressed before the first command is accepted) the program could become "hung-up" (see section 3.4.5) or, even worse, could terminate. Generally, the buffer stores multiple commands to avoid this occurence. However, when the system usage is heavy, there is no guarantee that this buffer will store the multiple commands safely.

Another bottleneck in the display usage can occur when accessing data from tape. Since frequently a large amount of data must be available for the display, it takes an appreciable amount of time to transfer data from tape to either the temporary disk or directly to the screen. Again, the amount of time involved depends not only on the system usage but also on the number of tape drives in use. Depending on how the user manipulates the data during the interactive session, he might find it faster to work either directly from the tape or store the data first onto the disk. See section 4.1 for help in deciding which method is the most appropriate.

3.4 Common Problems

There are several sporadic problems which the user may encounter on the digital display. Some of these he may solve himself; others will require assistance either from the computer operators or the supervisors. The following is a list of these problems and their solutions.

3.4.1 Lightpen Malfunction

There are two main lightpen malfunctions with several probable causes for each. The first problem is an improper positioning of the lightpen-selected point on the screen. The second and more serious problem is a total malfunction of the pen. The following sections discuss each possibility.

3.4.1.1 Point Positioning

The problem of lightpen point positioning can actually have several possible causes depending on the nature of the malfunction. For example, if the lightpen is pressed against the screen near the bottom of the display and the corresponding point appears near the top of the screen then the most likely

cause is that the image is being rewritten. If the lightpen is used while a new scene is being written over the old one, all points will automatically appear on the new portion of the image appearing on the screen. If a point is requested which is still part of the old image, then the point will automatically be positioned at the bottom line of the new image presently being written on the screen.

On the other hand, if the points are being displaced frequently and in random directions, then the source of the problem might be that the lightpen point positioning is out of adjustment. The lightpen-selected point should generally be placed within 5 pixels of the data point appearing directly between the two dots of light being shone on the screen by the lightpen at the time the pen is activated. If the placement varies any more than this, please contact the pictorial interface supervisor.

The angle at which the lightpen is held when it is depressed can also cause a point displacement, although generally the angle should not effect the positioning. The two beams of light from the pen determine the actual placement. However, holding the pen perpendicular to the screen when activating it should avoid any possible positioning problems.

3.4.1.2 Total Malfunction

This problem can either be localized, affecting only certain portions of the screen, or it can occur over the entire screen. Generally the malfunction will be sporadic and here patience and repeated efforts - spaced as much as 30 seconds apart if the system is responding very slowly - will usually pay off. However, the only permanent solution will be to contact the pictorial interface or computer operations supervisor. If they are not available, then senior computer operators have been trained to deal with the most likely causes and implement an immediate - though temporary - solution. The user should never attempt to make any adjustments himself or hit the lightpen forcefully against the screen. This could only serve to complicate the problem.

3.4.2 Camera Malfunction

If the camera shutter and film advance buttons on the photocopy unit fail to operate, then one of the following is probably the cause of the problem:

1. The mode switch on the PCU control box is in the wrong position. It should be in local mode for everything except the automatic 35mm option in *PHOTO.

2. One of the power control cables is not properly connected. This includes the connections between the PCU power box and the camera lens units as well as the cord between the two 35mm camera parts.

3. The power is not on in the Photocopy unit. The "power on" button on the power box should be lit. If not, press the button to restore power. It may take about 30 seconds for the image to appear.

4. The film in the 35mm camera has run out. It will be necessary to contact either the pictorial interface supervisor or one of the computer operators listed on the 35mm film schedule to put in a fresh roll.

5. The pressure plate in the 35mm film magazine is up. This is the last possibility to be checked and requires one of the persons referred to in (4).

The first three steps listed should be checked out first by the display user. If the camera still fails to operate, then contact the senior computer operator or the pictorial interface supervisor to check out the last two possibilities.

A copy of this malfunction list is posted by the display for reference.

3.4.3 Screen Visibility And Image Clarity

Sometimes it will be difficult to clearly discern the features on the screen. One of the main reasons for this is the brightness of the area surrounding the display. For this reason, the overhead lights should be turned off whenever possible to alleviate the glare on the screen. It might also be of help to look at the image in the photocopy unit since the data is much more concentrated.

Under no circumstances should the user ever attempt to adjust the brightness and contrast himself. These controls have been set to make all 16 gray levels discernible. Any change in settings will probably delete some of this distinction. If it ever appears that all 16 gray levels are not visible, the pictorial interface supervisor should be notified.

3.4.4 Severe Image Distortion

This problem, identifiable by a "dancing" motion of various lines and/or extreme image distortion, will occur to data present on the screen when the computer is completely shut down and then reactivated. This will not effect the program since any program must be restarted at this point regardless. However, if this should ever occur to the image at any other time, please notify immediately the pictorial interface supervisor, the computer operations supervisor, or the full-time senior computer operators.

3.4.5 The Display System "Hang-Up" Problem

This problem, unique to the digital display system, has several possible causes - either hardware or software based - all with the same symptom: The entire display system does not respond to any user-initiated command.

The problem can occur at almost any point in the program. In some instances, the user may not even be aware of the problem for some time. The following is a list of places in the display session where the problem has been known to occur:

1. After the 'Device 2A0 Attached' message appears at the terminal - At this point function key 30 is pressed and, depending on the system response, the screen is blanked and terminal responds almost instantaneously. Pressing key 30 a second time might activate the system. However, if, after waiting at least 3 minutes, no response has occurred, notify the computer operator.

2. Lightpen Point Placement - If no point appears on the screen within about 30 seconds, possibly longer if the system is heavily loaded, try entering another point. If the same response problem occurs, reject the points by using function key 17. If the system is functioning, the key light will go out, causing the other usable function lights to come on. However, if there is no response to this command, the display is probably hung-up and the senior computer operator should be told.

NOTE: If much grayscale variation occurs from one point to the next on the image, the user might have difficulty seeing a lightpen point being displayed. If the user cannot determine if a certain point is present on the screen, he may try inputing four values and wait to see if a boundary is drawn. If not, he should press the REJECT REQUEST function key and try again. Even though a point may not be visible, the line across the screen where it should appear will momentarily brighten when the command is accepted. This should be discernible with a little practice in watching for it.

3. Acceptance of lightpen boundaries - If after pressing both boundary accept keys no response occurs - again several minutes should be allowed if the system is slow - the display is probably hung-up. This problem can occur if the two keys are pressed simultaneously or in rapid sequence, especially if the system is very slow. Therefore, caution and patience should be exercised at these times.

4. Multiple key selections - If several keys (or the same key) are pressed before a response to the first has been received, the system may again become hung-up. This shouldn't happen in most cases. When it does occur, it is usually when the system is heavily loaded. Again, contact a senior computer operator or supervisor.

The above list described common occurrences of a display hang-up and how to recognize it and possibly avoid it. If a hang-up should occur, contact the senior computer operator, pictorial interface supervisor or computer operations supervisor to correct it. The procedure involves entering CP mode at the display user's terminal (hitting the ATTN or BREAK key). The operator then stops the system momentarily while he resets the display at the console control unit. After the operator has restarted the system, hit 'b' and the return key at the terminal to return control to the display program. If this should fail, the program will have to be reinitiated (IPLed).

If the problem which caused the hang-up is not similar to those listed, contact the full-time senior computer operator, (if on duty) or the pictorial interface supervisor to witness the problem and possibly a program dump on it before resetting the display.

3.4.6 The Display System Powering Off

If the image on the display screen should suddenly blank out, the display system could have lost power to the monitor. If the problem is not a general one effecting all system equipment, it can probably be solved by pressing the "monitor power-on" switch on the control unit. It will take 30 seconds to a minute to see a response on the screen. The POWER ON lamps are not always reliable indicators of the display's condition. It may be necessaru to press the button again if no response occurs. The problem should be brought to the attention of the pictorial interface supervisor, full-time senior computer operator or computer operations supervisor.

4.0 Making the Most of the Digital Display -- Some Techniques and Approaches

This section is designed to help the user select the best methods for handling digital display data. These are tried methods and proven approaches to viewing and handling data on the digital display in the most efficient, inexpensive manner possible. This section also contains information on how to best enhance the data being displayed and the imagery produced from it.

Each user will undoubtedly develop his own system for using the digital display in the best possible manner. This section is designed merely to give him some ideas to implement as he sees fit. If any user should develop his own display techniques or aids for more efficient use of the digital display, these ideas should be communicated to the pictorial interface supervisor for the benefit of all display users.

4.1 Disk Versus Tape Drive - The Most Efficient Approach

There is no clear answer to determining which of these two input devices is most efficient to use during the interactive session. If using the disk, the time spent loading the data from tape to disk during the initialization session can vary from a few minutes to several hours. This is dependent upon two main factors: (1) the system response time (i.e. how heavy system usage is) and (2) the amount of data to be transferred. However, once the data is on the disk, it can be accessed very rapidly compared to tape. If the system is not heavily loaded, the data is displayed just as fast as it can be written on the screen, usually less than half a minute. At the most, it shouldn't take more than five minutes to display the entire image.

On the other hand, working directly from the data tapes eliminates the data transfer during the initialization process. In other words, it provides the most rapid initial access to the data. However, it takes just as long to display the image on the screen directly from tape as it does to initially load the data on the disk. (The retarding factor in each case is the speed of the tape unit itself.) It is the best approach only as long as the image is not going to be redisplayed or excessively manipulated requiring more input from the tape.

One other factor to consider when selecting an input device is that the disk constricts viewing to only the area selected by the DISPLAY RUN card. In other words, when using the disk, the user cannot roll or specify a new line outside of the initially selected data set. However, when working directly from tape he can select areas beyond the limits of the initial image using the ROLL or SELECT NEW **AREA** functions.

Therefore, the most efficient method depends to a large extent on what data manipulations the user performs during the interactive session. The following is the best guideline for selecting the method of data handling to use:

> If little time is spent in data manipulation, working directly from the tape is generally faster. Conversely, if the data is to be manipulated much during the interactive session, the rapid data accessibility of the disk is necessary.

The functions which diminish the efficiency of the tape drive as an input device are:

- ENLARGE PICTURE
- RESTORE PICTURE
- ROLL (The effect of this function on tape efficiency is minimal.)
- SELECT NEW AREA
- CHANNEL SELECTION (IMAGEDISPLAY only)
- PRODUCE COLOR PICTURE (PHOTO only)
- SIZE OF REQUESTED AREA TO BE DISPLAYED

Except where noted, these factors apply to both IMAGEDISPLAY and PHOTO.

NOTE: The initialization session can be operated in the disconnect mode so that it is not necessary to tie up a terminal and user time during the data transfer. However, this convenience should be used with discretion. Since it involves tying up a system temporary disk until the interactive session begins, the data should not be left on the disk any longer than necessary. Another point to remember is that if the system should crash while the data is on the temp disk it will be lost just as in a regular session. The longer the data is left on the disk the greater the chances are of such a problem occurring.

4.2 Histograms and the Grayscale Concept

The procedure for assigning gray levels is discussed extensively in the LARSYS User's Manual Volume 2 (IMA 7-11). This section deals solely with the reasons for choosing one method over another.

The standard gray level assignment consists of 16 equal probability data ranges (levels) using previously calculated histograms for every tenth data sample and line for each channel. If desired, the following options can be used to replace any one part or all of this standard assignment.

A. User selected number of gray levels
B. User selected area from which the histograms are to be calculated
C. User assigned data ranges for each level
D. User defined gray level values
E. User selected histograms

Determining which method is the best to use in a particular case is not always obvious. The standard assignment is based upon experience as to what the best values would be for an average LANDSAT data frame. This can vary from one image to another so that an alternate form might be indicated.

In general, for relatively small areas (say less than 50,000 points), it would probably be best to histogram all data points. For larger areas, every other point or less should be histogrammed. When considering the amount of computer time involved, the following two rules of thumb are helpful:

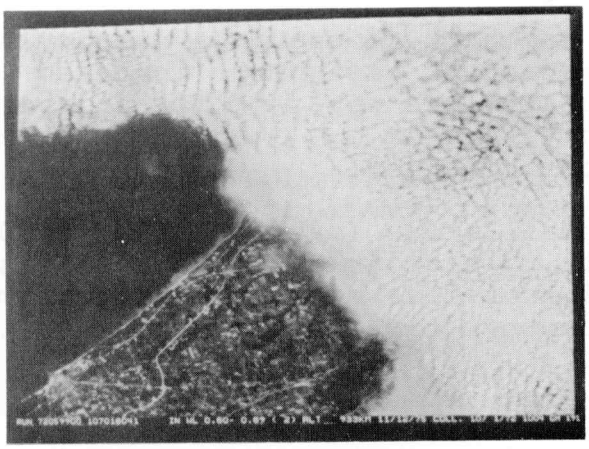
1. Increasing the number of wavelength bands increases histogramming time only slightly. (Since only channels histogrammed can be displayed, it is advisable to histogram all channels which might be accessed.)

2. Increasing the amount of data points histogrammed significantly increases the computer time used.

The following are several examples where alternate histogramming methods are desirable. Figure 4-1a shows a data set using the standard gray level assignment to represent the data. Note the large amount of clouds in the scene. These clouds are contributing to the dark overall appearance and lack of contrast in the rest of the scene. Figure 4-1b shows the same area but with histograms computed for only the area outlined using a BLOCK card. It can be seen from this image that the standard histogram assignment for the entire area displayed may not always be the best for any given portion of the frame. In this case the high spectral response of the clouds biased the data set towards the darker region of the image giving the standard data a general lack of contrast and dark appearance.

4-1a
Southern Lake Michigan area
LANDSAT data
Full data set
histogrammed

Scale 1/1



4/1 scale

4-1b
Southern Lake Michigan area
Boundary indicates
the subset histogrammed
to produce the image.

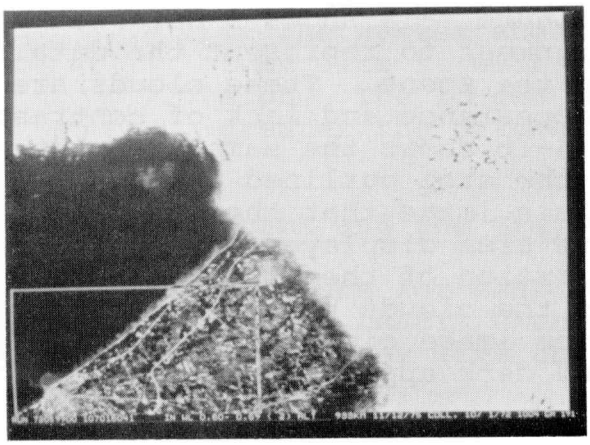


Figure 4-1

Cloud Effects on Histograms

Other cases where a change in gray level assignment might be useful would be: 1) when the data has very few variations or a small range in spectral response. In this case a smaller number of gray levels indicated on the SYMBOLS card would be desirable; 2) when the histogram's apparent divisions can be seen which do not coincide with the standard allotment for the data set. In this case it would probably be best to define the appropriate ranges on a LEVELS card; 3) there can often be seen a loss of detail when going from a large data set shown in Figure 4-2a to displaying only a small part of it. Figure 4-2b gives such an example. When there is such a difference in size and overall composition, calculating new histograms for the small area would help to enhance the data even more as Figure 4-2c shows; 4) when working with geometrically corrected data, it is important to choose a subset area for histogramming which does not include the "wedges" or background level of the data set. Figure 4-3a shows the resulting image when the entire data set is used to calculate the histograms. Figure 4-3b shows an appropriate outlined area used in the BLOCK card for selecting the histogram subset which produced the image in Figure 4-3c.

In general, if the scene features the user wishes to display are not typical of the entire data set to be histogrammed using the standard option, or if the histograms show definite points of delineation he should experiment with different display options.

4.3 How to Locate a Particular Area Using Photographic and Digital Display Aids

When viewing a scene for the first time on the digital display (and often in subsequent sessions as well) it will generally be necessary to have either road maps or imagery of some sort available as a reference. There is a light table provided by the display for use with transparencies. It also adapts to flight rolls of film. Frequently road maps or geologic maps can help a user locate particular scene features. There are also digital display aids available which might be of help in locating a desired subset of data to be displayed.

Since most problems in locating scene features seems to arise with satellite data, this discussion will pertain mainly to this form. However, many of the concepts are equally helpful for aircraft data as well.

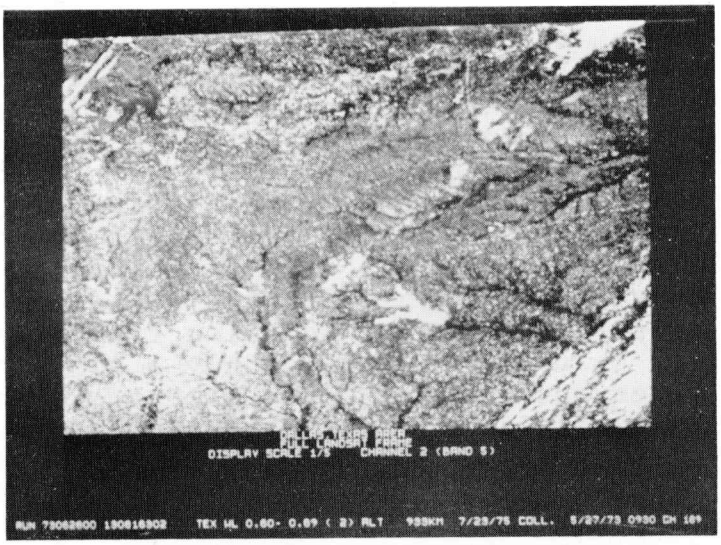


Figure 4-2a
Full frame data set
Dallas, Texas area
LANDSAT data

Figure 4-2b
Dallas, Texas area
Using full frame
histograms

Figure 4-2c
Same area as, (b)
Histograms for
area displayed

Figure 4-2

Histograms: Full Frame
Vs. A Small Subset

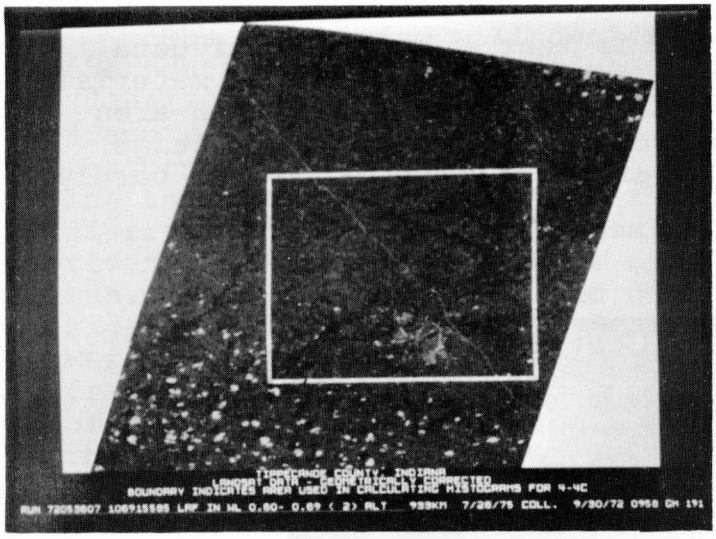


Figure 4-3a
Geometrically corrected data
Gull frame histograms used
Tippecanoe county, Indiana
LANDSAT data

Figure 4-3b
Outlined area selected
For new histograms

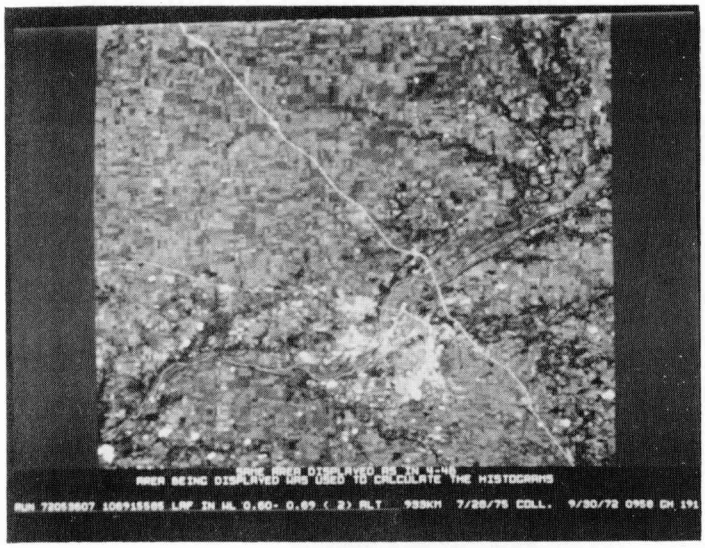


Figure 4-3c
Same area as (a) and (b)
Using histogram subset
shown in (b)

Figure 4-3

Using the BLOCK Card For
Histogramming

The first point to remember is that a large set of data should not be displayed without some sort of reference material at hand to help pinpoint the area of interest. An urban area the size of Denison - Sherman, Texas, which fills up a large part of the screen at 4 pixels per point (Figure 4-4) is barely discernible in the

Figure 4-4
Denison - Sherman, Texas Data - Scale 4/1

full data frame (Figure 4-5). Therefore, the first part of this discussion will apply to locating a smaller area of a large frame of data.

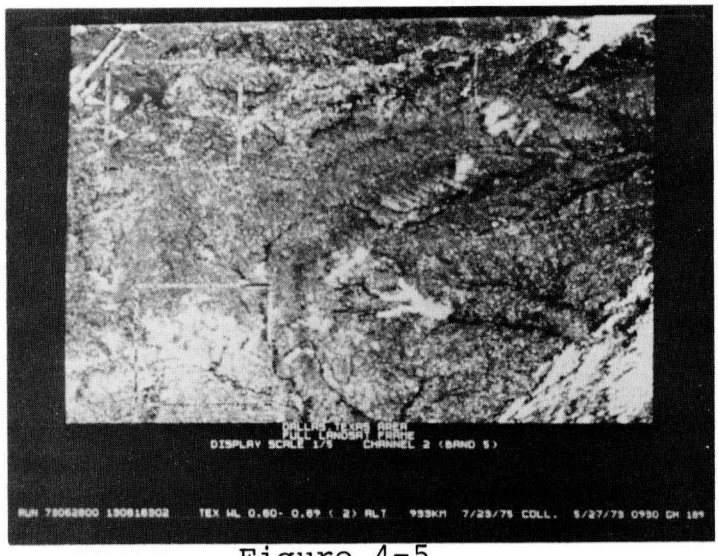


Figure 4-5
Full Frame of North Eastern Texas - Scale 1/5
Can you find the Denison - Sherman Area?

The first case will deal with displaying a partial run of the Southwest part of Indiana using frame 1105-15595, run (72041200) as an example. This run is approximately 3/4 of a frame reformatted with no geometric corrections or overlays performed on the original data set. We are interested in locating the city of Vincennes just north of the junction of 2 rivers: the Wabash (north-south) and the White (east-west) rivers. Figure 4-6a shows a sample image (band 5) for the entire run. Note that there are no distinctive features in the image. Figure 4-6b is also of the same area but was taken in band 7. Water is often a good feature to use in locating a portion of the frame since its spectral response usually offers a high degree of contrast with the surrounding features. A river the size of the Wabash will consist of several data points across its width as opposed to a highway which may be only one data point wide. For this reason it would probably be of the greatest use in locating Vincennes from a large data set.

Therefore, after preparing the data deck for the full run and beginning execution, the first channel selected will be channel 4 (band 7 of data). Unless the user wished to view the entire frame first, the appropriate area can be enlarged just as soon as it is recognizable on the screen. Remember, when enlarging an area only the column and top line boundaries are important since the data will automatically be displayed to the bottom of the screen (or end of the data set). Figure 4-8a shows the boundary area selected. The width of it as it would appear on the main display screen is exactly 13.2 cm (5 1/8"). This area was selected using the chart on the digital display bulletin board shown in Figure 4-7. This chart indicates exactly how wide an area the user can select to be displayed in order to fill the entire screen with data at any given scale.

For example, we are looking at a 3/4 data frame where every 3rd data point is being represented. This is a scale of 1/3 Now if an area is desired to be enlarged from this scale to one where every data point would be displayed by one picture element (a 1/1 scale) then the circled value of the boundary width is the maximum width the rectangle can have. After selecting a region whose width corresponds to these values, the enlarged area shown in Figure 4-8 results with Vincennes appearing quite noticeable.

The second method for locating a small area within a large frame deals with the smaller region being selected before the data is displayed. By using the line and column option on the DISPLAY card, the user can work directly with this smaller region.

Figure 4-6a
Southwestern Indiana
data
Full frame
Band 5 (channel 2)

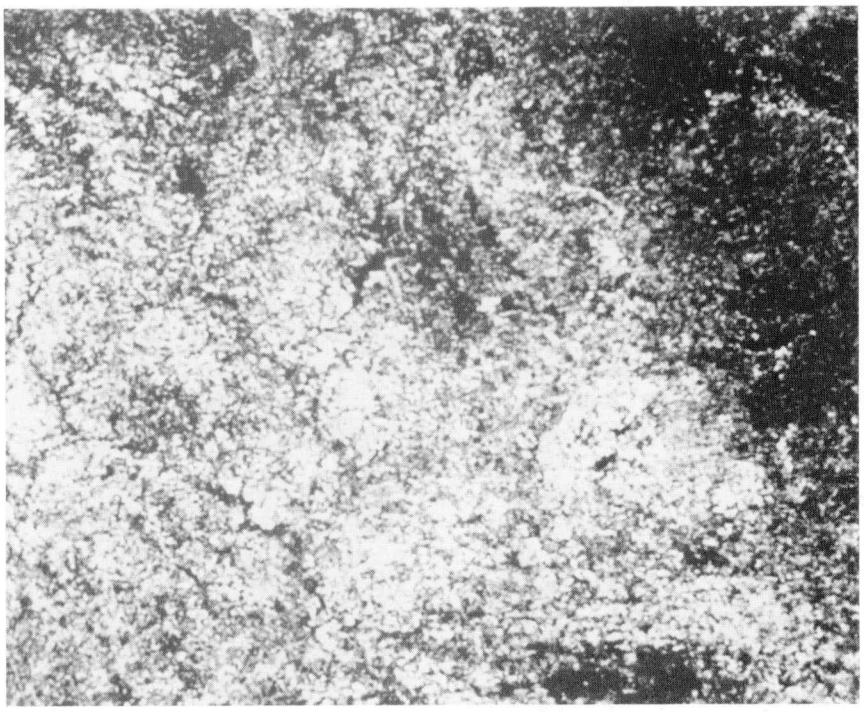


Figure 4-6b
Same image
Band 7 (channel 4)
Note Wabash River

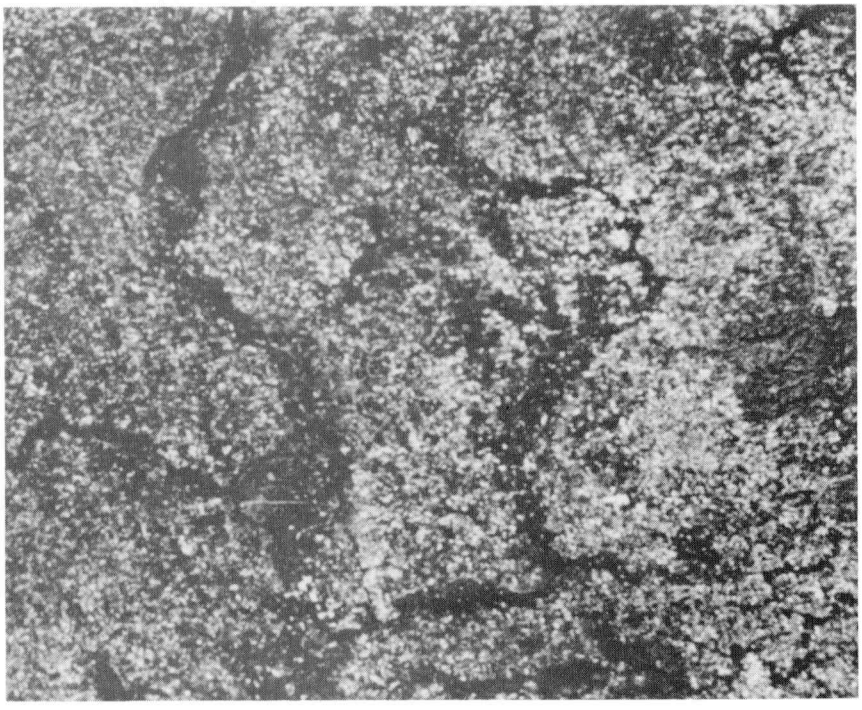


Figure 4-6

Comparison Between Spectral Bands

Column Widths For Maximum Data Enlargements

This chart will enable you to enlarge an image from a given scale to any other available scale so that the maximum amount of data may be displayed. Since lines of data are automatically displayed to the bottom of the screen, only the column dimensions are given. The only warning here is that your top boundary is set high enough so that there will be a sufficient number of data lines below it to fill the screen. The column width is the maximum allowable number of data points measured from the inside boundary edges.

The data scale ratios represent pixels/data point (i.e.,: 1/5 = 1 display picture element representing every 5th data point.)

at scale 1/5

To obtain a full frame display at: column width is:

SCALE	INCHES	CM
1/4	12 1/2	32.0
1/3	9 5/8	24.5
1/2	6 3/8	16.1
1/1	3 1/8	8.1
4/1	1 1/2	4.0
16/1	3/4	2.1

at scale 1/4

To obtain a full frame display at: column width is:

SCALE	INCHES	CM
1/3	11 7/8	30.4
1/2	7 3/4	19.9
1/1	3 7/8	10.0
4/1	1 7/8	4.8
16/1	7/8	2.4

at scale 1/3

SCALE	INCHES	CM
1/2	10 1/2	26.8
1/1	5 1/8	13.2
4/1	2 1/2	6.4
16/1	1 1/8	3.1

at scale 1/2

SCALE	INCHES	CM
1/1	7 7/8	20.0
4/1	3 7/8	9.9
16/1	1 3/4	4.7

at scale 1/1

SCALE	INCHES	CM
4/1	7 7/8	20.1
16/1	3 7/8	10.1

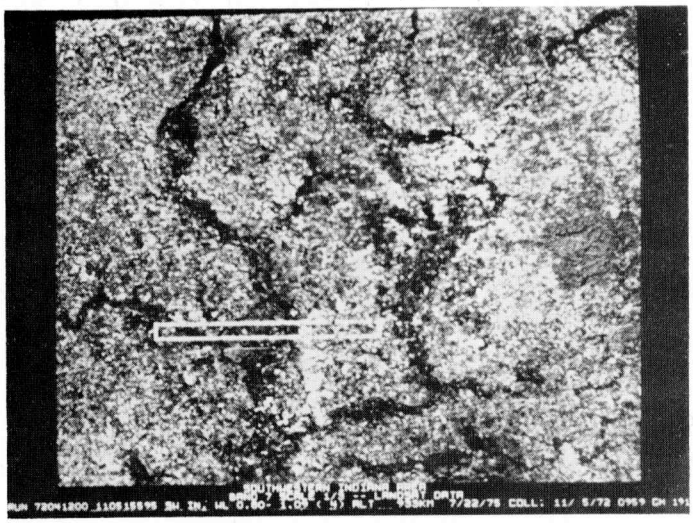
at scale 4/1

SCALE	INCHES	CM
16/1	7 7/8	20.1

Figure 4-7

The Display Enlargement Table

Figure 4-8a
3/4 frame with selected
Enlargement boundary
Outlined (boundary width)
is 8.1 cm on main screen)



After specifying
these boundaries using
the 'ENLARGE' Function, the
following data subset was displayed

Figure 4-8b
Vincennes area
Scale 1/1

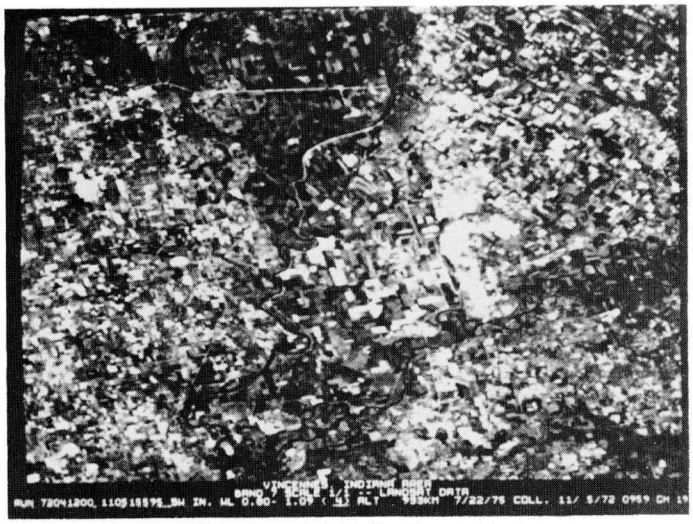


Figure 4-8

Enlarging Using the Table

In this manner the disk can be used if the area selected is small enough. For this example the Columbia, Missouri area will be selected before going to the display from the large data set shown in Figure 4-9.

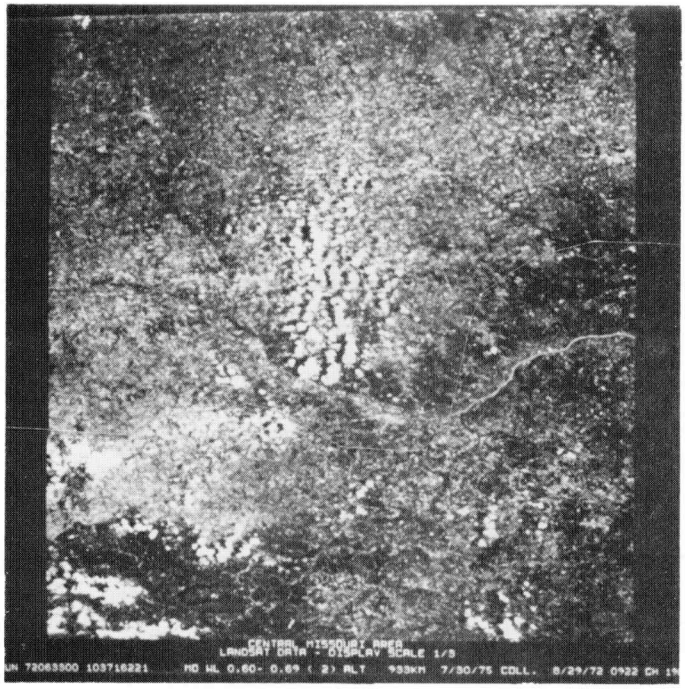


Figure 4-9

Central Missouri Area - Scale 1/3

The grid shown in Figure 4-10, available through the pictorial interface supervisor, can be overlayed with 9" transparencies to determine the line and column coordinates of a subset area to be displayed. If the entire run has been reformatted then the line and column values will be the precise ones to be used in the DISPLAY card. However, if only a subset of the area is reformatted on the particular run then a transformation will likely be necessary. It is of the form:

A+C = initial line

A+D = last line

B+E = initial column

B+F = last column

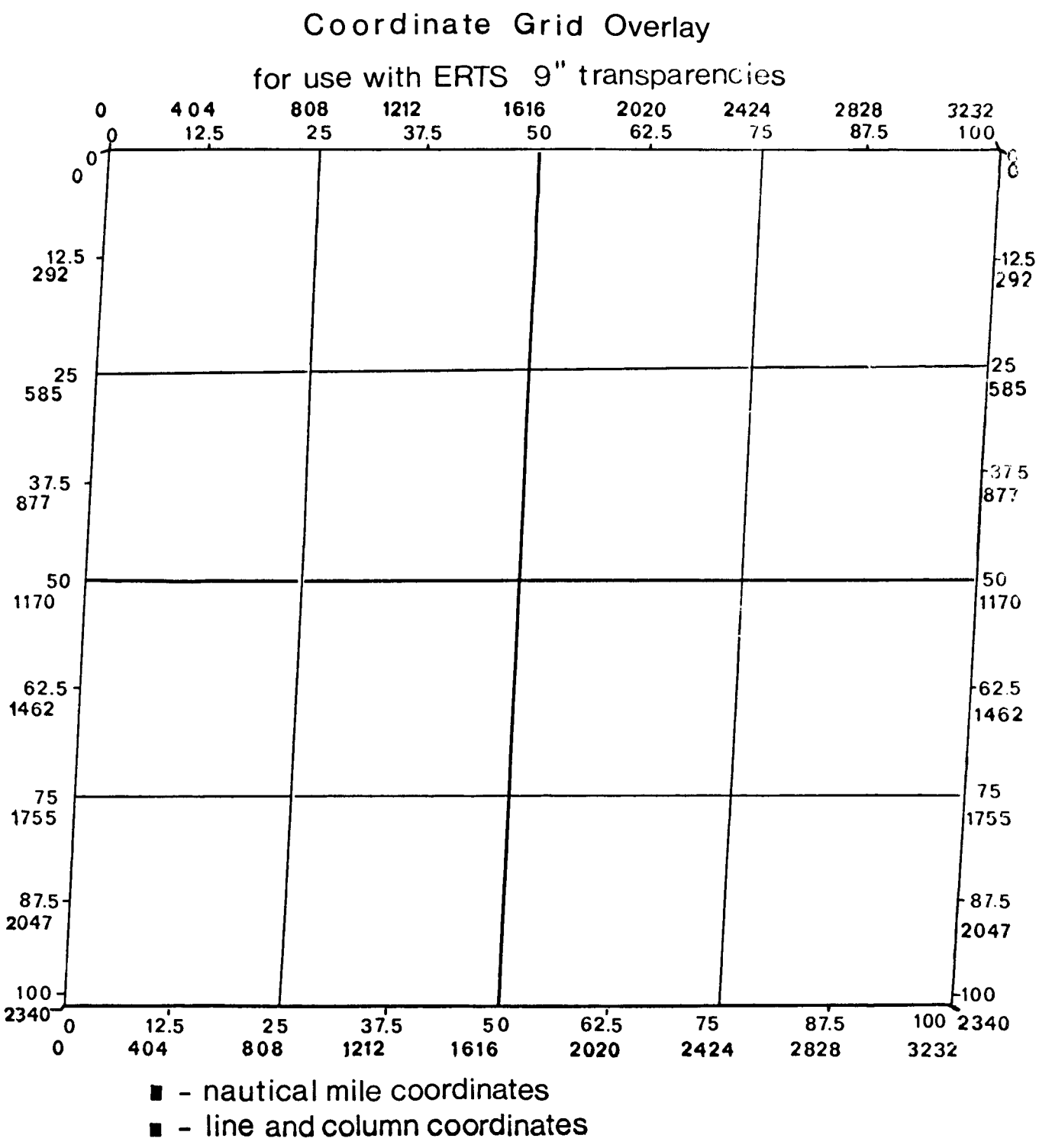


Figure 4-10

LANDSAT 9" Imagery Overlay Grid

where A = original data first line of the reformatted area
B = original data first column of the reformatted area
C = initial line selected from the grid
D = final line selected from the grid
E = initial column selected from the grid
F = final column selected from the grid

If the user desires to display the data so that the entire screen is filled, he can use the table shown in Figure 4-11 below (which is on the display bulletin board). The total lines and columns can be chosen from this chart to precisely fill the screen at any desired scale. (See section 4.4 for more details.)

TABLE OF SCREEN SIZES

Image Size*	Maximum Number of Lines	Maximum Number of Columns	Maximum Total Area (in data points) Represented
1/5	2880	3840	11,059,200
1/4	2304	3072	7,077,888
1/3	1728	2304	3,981,312
1/2	1152	1536	1,769,472
1/1	576	768	442,368
4/1	288	384	110,592
16/1	144	192	27,648

*Pixels representing each data point/line and column interval.

Figure 4-11

A Table of Screen Sizes
For Use With the Digital Display

If the area of interest selected from the grid is:
lines (750,1000,1) = 251 lines
columns (1800,2200,1)= 401 columns
then to fill the screen at a scale of 4/1 (according to the screen size table, a maximum of 288 lines and 384 columns) the coordinates where refined to:

lines: 288-251 = 37 additional lines or
(750-19) - (1000 + 18) or
731-1018 = 288 lines total

columns: 401-384 = 17 deleted columns or
(1800 + 9) - (2200-8) or
1807-2192 = 384 columns total

However, the area reformatted is:
lines 1 to 2340 and columns 1296 to 3233

Therefore, the actual columns for this run must be changed to reflect the subset reformatted:
(1809-1296) to (2192-1296) or
513 to 896

Thus, the initial area to be displayed was specified by the following input card:
DISPLAY RUN(72063300),LINES(731,1018,1),COLS(513,896,1)

After initializing the IMAGEDISPLAY program for this subset, the initial image displayed on the screen in channel 2 is shown in Figure 4-12.

Figure 4-12
The Selected Area on the Digital Display

If there are any questions regarding these procedures or if copies of the display aids are desired, please contact the pictorial interface supervisor.

4.4 Displaying the Maximum Amount of Data on the Screen at a Desired Interval

There are 3 methods for selecting a user specified data set to be displayed on the screen. The first of these is specified in the control card input during the initialization session. The remaining methods apply during the interactive session:

1. DISPLAY RUN card line and column coordinates
2. SELECT NEW AREA terminal-controlled keyboard function
3. ENLARGE PICTURE lightpen-controlled keyboard function

The technique used to display the maximum amount of data on the screen depends upon which of the above methods is used.

4.4.1 Display Run Technique

If the user wishes the original data set displayed to fill the entire screen, then the line and column coordinates should be selected carefully. This procedure is shown in an actual example (method 2) in section 4.3. The table in figure 4-11 shows the maximum number of columns that can be selected for the image to be displayed at a particular scale. The image will completely fill the screen in width if the total number of columns is exactly equal to the figure for the appropriate scale. Any amount smaller than that but larger than the maximum for the next enlargement will produce a narrower data set at the same scale. For example if the display run card reads;

DISPLAY RUN(72053621), LINES (1,1152), COLS (1,1535)

then the data set will be initially displayed at a scale of 1/2. If 1000 columns had been specified, the data set would still be displayed at 1/2 but would not fill up the screen in width. A column total of 768 would cause the data to completely fill the screen at the next possible enlargement: 1/1
Remember, the number of lines does not determine the scale at which the data is displayed. As long as your DISPLAY RUN card specified at least the maximum number of lines for the column-controlled interval, you will have a full screen of data displayed.

4.4.2 Select Coordinates Technique

The same theory behind the selection of coordinates for the DISPLAY RUN card applies to this keyboard - terminal function. However, filling the screen in this particular case can be done by simply specifying the initial line and column desired. This will cause the present image to be redisplayed at the same scale

but displaying the maximum number of columns and lines possible. To use this function to redisplay the image at a different scale requires specifying the last column as well. The scale requested again depends upon the number of columns selected as discussed in section 4.4.1.

4.4.3 Enlarge Picture Technique

This technique involves selecting 4 points using the lightpen to define the boundaries of the subset area to be redisplayed.

This procedure was employed in method 1 of section 4-3. It is discussed here in greater detail.

The chart shown in figure 4-8 is available by the display to help a user in selecting the appropriate area. Each block of information pertains to the scale at which the data is being displayed. The data within each block gives the boundary width necessary to fill the screen at each scale available from the one currently being displayed. Scale is defined here as being the ratio of display screen picture elements (pixels) to the data points being displayed or:

Scale = pixels/data point

The values are given in both inches and centimeters. There should be a flexible transparent ruler available in the drawer to the right of the display terminal.

After the approximate boundary has been outlines, the ruler should be used to measure how close the width comes to the prescribed value. The boundaries are then adjusted if necessary and the values accepted.

Remember, the distance is measured from the inner edges of the column boundaries. The value must not exceed those listed in the tables or the image will not be displayed at the appropriate scale.

To demonstrate the importance of knowing these limit values, the following example will give two enlargements. One will not use the limit values to obtain the enlargement boundary. The second case will use the precise width indicated to enlarge the image by two magnitudes. Figure 4-13 shows the original image at a scale of 1/2.

According to the appropriate excerpt for the table in Figure 4-7, shown below, the width of the rectangular area chosen should not exceed 9.9 cm or 3 7/8 inches to enlarge the image two orders of magnitude to a 4/1 scale.

Figure 4-13

Original image -- scale 1/2

Figure 4-14

Enlargement exceeding boundaries -- scale 1/1

at scale 1/2

SCALE	INCHES	CM
1/1	7 7/8	20.0
4/1	3 7/8	9.9
16/1	1 3/4	4.7

To demonstrate what happens when this value is exceeded, the first boundary selected was deliberately made about 4 inches wide. The resulting image when enlarged is shown in Figure 4-14. Note that not only does the image not fill up the screen but the desired scale of 4/1 was not quite reached since too much data was included in the boundary area.

Figure 4-15 shows the resulting image when an enlargement boundary with the precise width indicated on the tables is used. (Note: this is the precise boundary shown in Figure 4-13)

Figure 4-15

Precise Enlargement Desired -- Scale 4/1

It is interesting to note the location of the lower line of the boundary (Figure 4-13) in relation to the image produced after its acceptance (Figure 4-15). As stated previously:

> Only the upper and two side boundaries determine the actual boundaries of the enlarged image. It is a good practice to keep the lower boundary as close to the upper one as possible. This allows more efficient and rapid movement of the side boundaries if necessary.

4.5 Photographic Mosaics and the Effect of Data Compression

The problems associated with digital display imagery discussed in section 3.3 of this guide have a very pronounced effect on mosaics made with either polaroid or 35mm imagery. Mosaics are made by piecing together a number of images to show more data than can be represented at one time using the display.

The more uniform the data features are across the images the more apparent effect the data distortions will have on the whole mosaic. There are various methods for piecing the data, one of which might help to alleviate any distortion problems. In general, excluding approximately the top 1/4 of the data and possibly the bottom 1/8 is a good practice. The rippling effect and barrel distortion on the left side of the image makes it advisable to delete about 1/4 of this data as well. Figure 4-16 shows an image appropriately divided.

For further information concerning mosaics, contact the pictorial interface supervisor.

4.6 Average Estimates of Digital Display Attach Time and CPU Time

Table 4-1 gives an average estimate of the charged time needed to carry out the described terminal actions. These values can be expected to vary depending on system usage, size of the data set, etc. However, they should be within several minutes (CPU time) of the average amount.

No appropriate estimate can be given of display attach time for any function not systematic and thus fairly independent of users' various techniques. Therefore, the only display attach times given are for definite functions where such an estimate can be made with some degree of reliability. Again, slow system response can cause a considerable increase in these values.

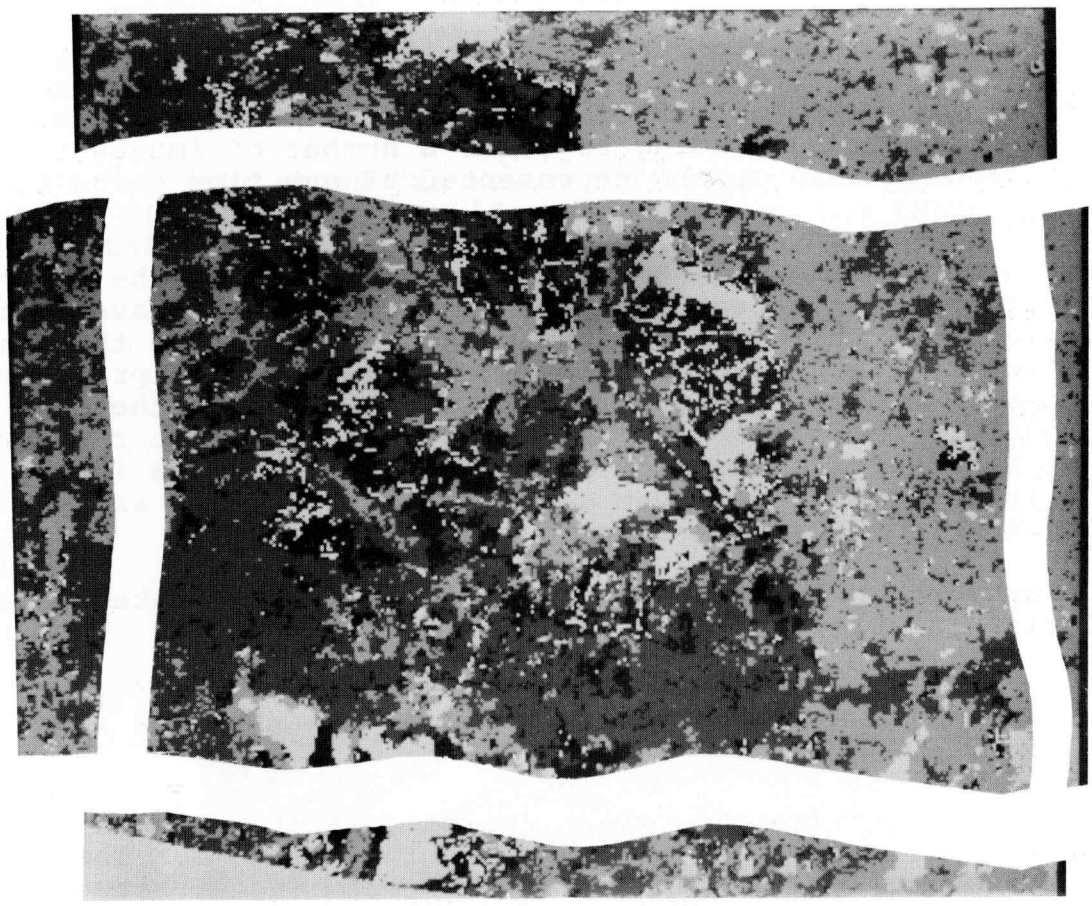


Figure 4-16
Dividing a Display Image For a Mosaic

It would be best to allow a wide margin of time if any work is to be done during the hours of 8 A. M. - 5 P. M., Monday through Friday. Better system response can be expected at any other time. However, the best response time will occur between midnight and 8:00 A. M. or on weekends.

Action	Computer Time Average (Range of test values)	Attach Time Average (Range of test values)
TERMINAL SESSION	6m0s (1m17s-19m)	1h12m0s (20m-2h 39m)
HISTOGRAMMING (display not attached)	0m30s (7s-44s)	8m20s (2m-15m)
DISK STORAGE (display not attached)	2m25s (0m37s-5m0s)	10m0s (3m-45m)
COLOR PICTURE	1m23s (0m54s-2m30s)	15m0s (3m-40m)
ENLARGE	0m16s (13s-17s)	1m16s (30s-2m0s)
CHANNEL SELECTION	0m36s (18s-52s)	7m22s (1m30s-15m)
RESTORE PICTURE	0m26s (15s-39s)	3m2s (1m11s-4m32s)
EDIT FIELDS	0m5s (4s-6s)	2m0s (1m-3m)
TITLE (3 line average)	0m15s (1s-4s)	2m30s (20s-8m0s)
ROLL	strongly dependent on amount of rolling done--generally insignificant CPU.	
BACKSPACE FRAME	Instantaneous No significant time involved	

Table 4-1

Average CPU and Display Attach Time Estimates

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PART II

THE PHOTOGRAPHIC MANUAL

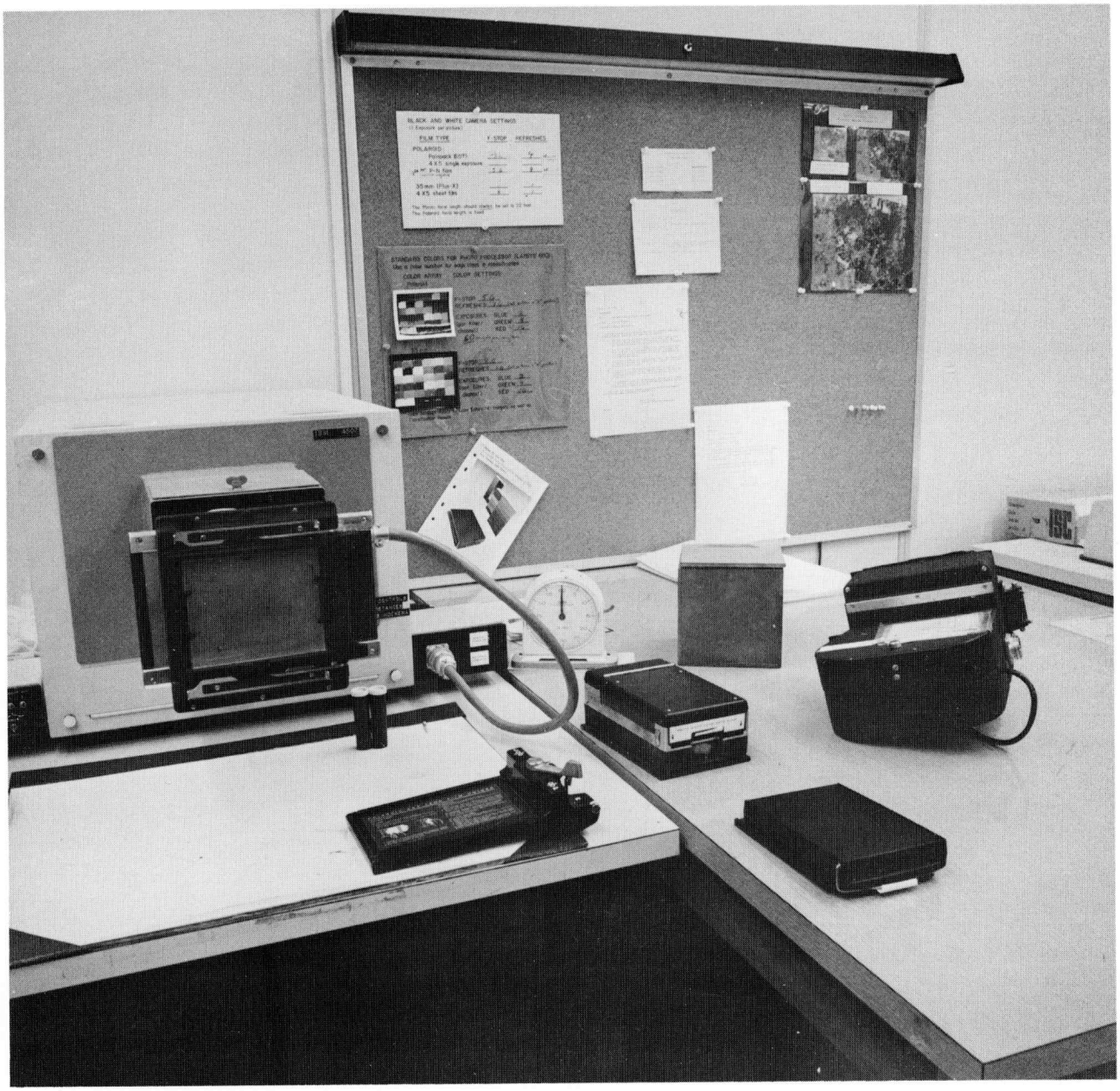


Figure 1-1
The Photocopy Unit

1.0 The Equipment

The photocopy unit (PCU) produces hardcopy imagery of the scene on the digital display screen. (See Figure 1-1) This unit is, in effect, a smaller version of the main display screen showing the same image in miniature. The front of the PCU has a hinge and mount for attaching the various camera units in order to photograph the image being displayed. There are two basic cameras, one for 35mm film and the other for Polaroid packs and 4 x 5 film.

1.1 The 35mm Camera

Refer to Figure 1-2 while reading the following description.

1.1.1 Description

The camera consists of two parts: (1) the lens unit which mounts directly onto the photocopy unit and (2) the camera back or magazine which houses the film. When loading film into the camera, only the magazine is necessary.

1.1.2 Attaching The Units

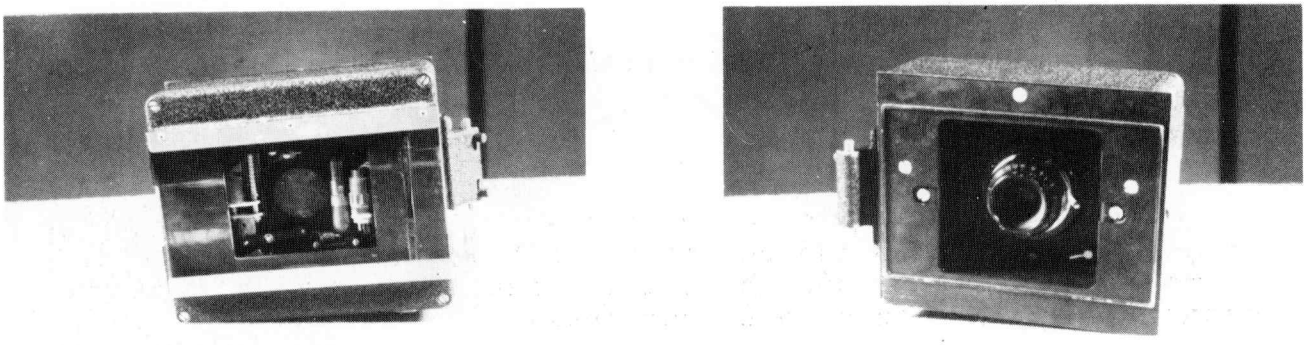
To attach the lens unit to the photocopy unit the user should hold the lens section firmly and, depressing the tabs on the right side of the camera (which pull the two prongs into the adaptors), insert the adaptors into the corresponding holes on the PCU as shown in Figure 1-3. Release the tabs to secure the prongs in place. The quick disconnect latch on the left side of the photocopy unit latches onto the pin on the camera to hold it firmly in place. To check the lens setting, only this latch needs to be released. The power control cable prongs fit into the receiver in only one direction on the right side of the lens unit. The user should push the plug in firmly and screw the fitting tightly in place.

To attach the camera back to the lens unit requires sliding the back into the horizontal grooves from the right side of the lens unit. The magazine must be pushed in all the way to prevent possible blurring of color images. The 6-pin connector on the bottom of the magazine should be attached to the receptacle on the bottom of the lens section and screwed firmly in place. The user should always be certain the dark slide (which fits in the left side) is covering the camera back aperture as in Figure 1-2 when the magazine is exposed.

The Lens Unit

Back

Front



The Film Magazine

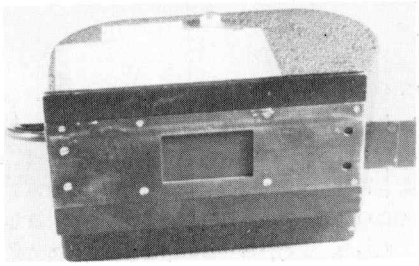


Figure 1-2
The 35mm Camera System

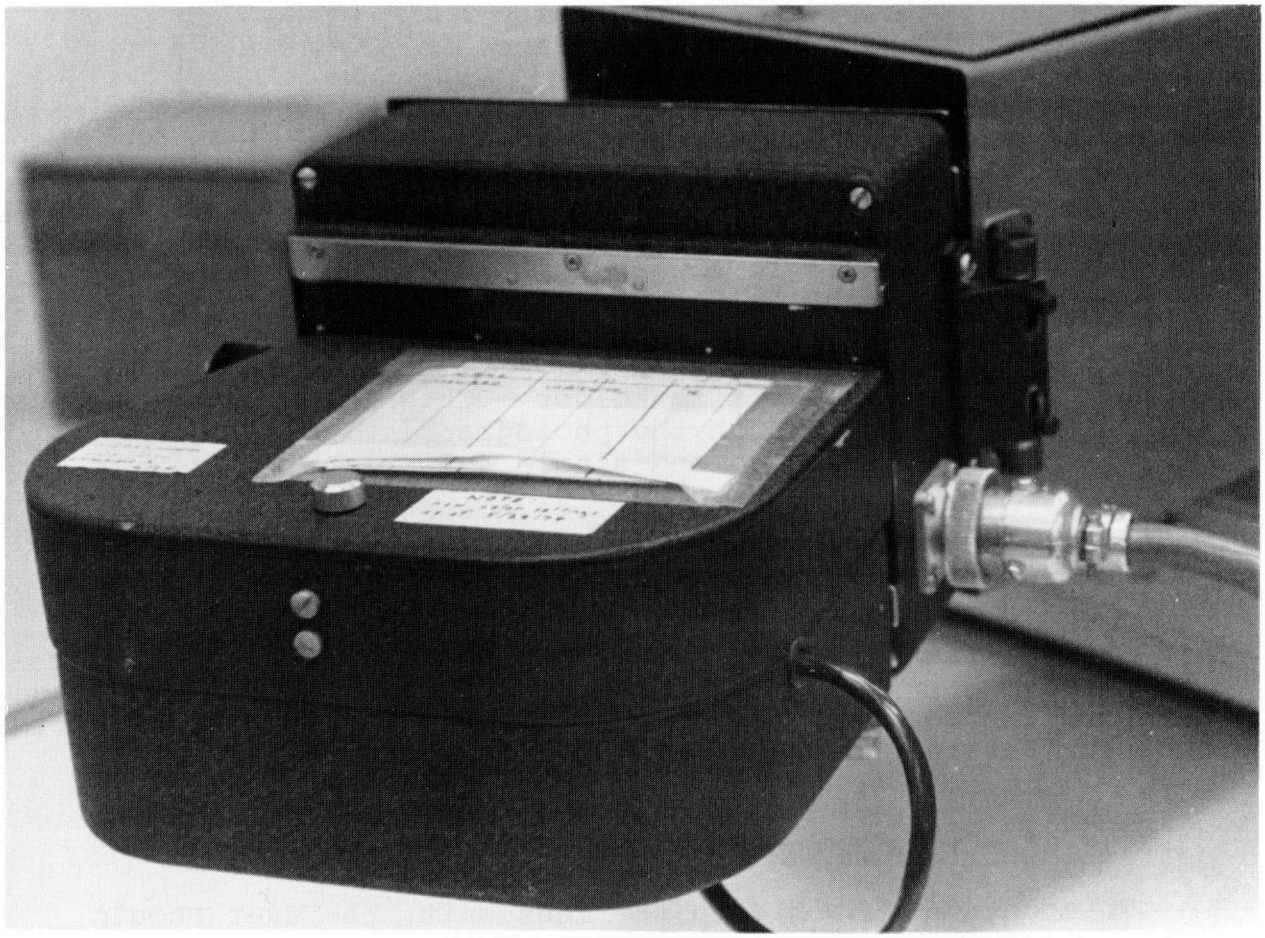


Figure 1-3
Attaching the 35mm Camera

1.2 The Polaroid And 4x5 Cameras

Refer to Figure 1-4 while reading the following description.

1.2.1 Description

There are six basic units to the 4x5 Polaroid camera system. They include:

(1) The lens unit - Two different camera backs, (2) and (3), can be mounted on it.
(2) The Polaroid polapack camera back - This magazine holds the 8-exposure packs of Polaroid film standardly used.
(3) The 4x5 attachment - This back can be used to hold any of the following magazines:

    (a) The Polaroid single exposure film holder - Not used very often, this magazine holds Polaroid 4x5 single exposures.
    (b) The 405 film pack (Polapack) adaptor - This recent addition holds the same commonly used film packs as (2).
    (c) The sheet film holder - This holder, obtainable through the photographic lab, uses Plus-X or Ektachrome-X single 4x5 sheets of film.

1.2.2 Attaching The Units

The 35mm procedure is used to attach the polaroid lens unit (see section 1.1.2). Either of the backs are mounted by sliding them in place at the back of the lens section (see the following two sections for more details). There is no electrical connector between the lens unit and its camera backs.

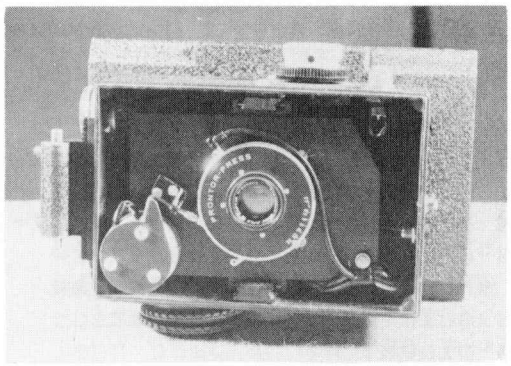
1.2.2.1 The 4x5 Attachment

To mount this back onto the lens unit, the user should simply slide the open end into the grooves on the back of the lens section. The arrow on the back should line up with the number '7' on the lens unit. The alignment should be checked occasionally since this attachment does not lock into position.

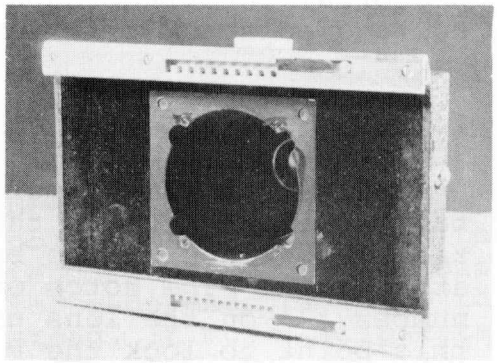
To load any of the three types of film holders into the attachment the user should slide the desired holder in front of the translucent plate on the right side of the attachment.

The Lens Unit

Front

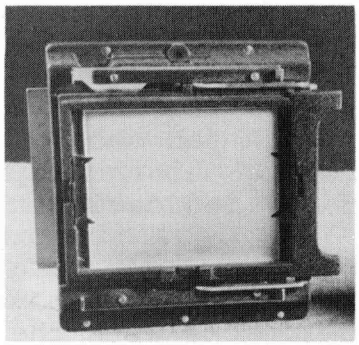


Back

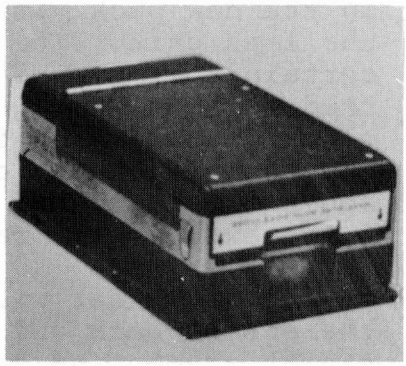


The Magazines

4x5 Attachment



Polapack Back

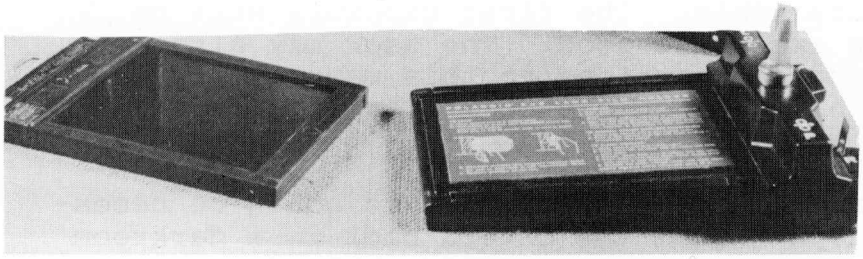


The 4x5 Film Holders

Sheet Film

Polaroid Single Exposure

Polapack Adaptor



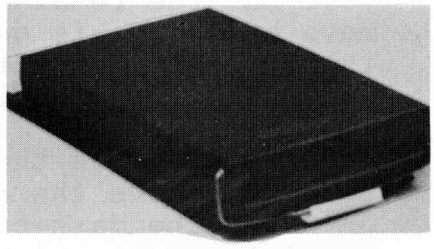


Figure 1-4
The Polaroid Camera System

This attachment has a spring hinge which pulls out easily to admit the film holder. It then automatically grips the holder firmly in place. Be certain the film holder is inserted all the way.

To load the film for these holders the user should see the pictorial interface supervisor. Section 1.2.2.3 describes how to load polapack film into the 405 adaptor.

1.2.2.2 The Polapack Camera Back

To mount this camera back the user must first pull the tab key on the top of the magazine back and then slide the magazine into place on the back of the lens unit as with the 4x5 attachment. The notch on the magazine should line up with the number '7' on the lens unit. The tab should be released at this point to lock the Polaroid back in place.

To load either black and white (type 107), color (type 108) or positive-negative (type 105) polapacks, the user should push the lever on the bottom right hand side of the camera back to the left. This causes the film door to spring open. If an old cartridge is still in the back he must remote it and slip in the new pack with the black paper protected side facing toward the lens unit. The film door should then be closed, making certain that the black paper tab from the film pack is protruding from the right side of the camera back. The door will click thus locking it into position. The black tab should then be pulled out of the camera back. A white tab should appear in its place marked with the number '1' indicating the first exposure is ready to be taken.

If the user wishes to switch film types, he must remove the entire back and mount one of the 405 polapacks with the 4x5 attachment as discussed in the next section. There are three of these new 405 adaptors available. Therefore each film type should have its own polapack back.

If for some reason it is necessary to remove a partially used pack it should be removed as an empty cartridge would be and placed on the camera table. The first exposure will be lost but the remaining are still good. The user may also remove and keep his own unused portions in this manner, storing it in a film box with his name on one of the tables, in a drawer, or keeping it with him.

To preserve the first exposure as well, it would be necessary to remove the old pack from the camera back in a darkroom or using the dark bag in the cabinet to the right of the terminal. The film pack must be placed into a light-free container until ready to load into the camera again under darkroom conditions.

Always be certain to pull out the dark slide before taking a picture.

For more detailed instructions concerning the 405 polapack adaptors the user should read the instruction manual posted on the Photocopy Unit Bulletin Board.

1.2.2.3 The 405 Film Pack (Polapack) Adaptor

There are two 405 film pack adaptors available for use with the display camera system. This polapack adaptor holds the same commonly used film types as the standard polapack back discussed above. However, it is not mounted independently onto the lens unit as is the polapack back, Instead, it must be inserted into the 4x5 attachment as discussed in section 1.2.2.1.

To load film, the 4x5 polapack adaptor must be removed from the 4x5 attachment. To open the back, the metal bar on the right side of the adaptor must be pulled up. The back can then be opened and a new film pack inserted using the same method discussed in the previous section. To close the user simply presses the bar down until it clicks into position. He is then ready to reinsert the back into the 4x5 attachment.

Unless the dark slide is covering the film opening on the adaptor the black protective paper should not be pulled out until the user has reinserted the back into the attachment. Always be certain to pull out the dark slide before taking a picture.

For more detailed instructions concerning the 405 polapack adaptors the user should read the instruction manual posted on the Photocopy Unit Bulletin Board.

2.0 The Film

This section discusses the kinds of film standard in usage for the digital display. Their availability and usage is also indicated.

2.1 Black And White

There are 3 kinds of black and white film compatible with the digital display camera systems. They are indicated below with the film types commonly used. Those kept in constant supply are marked with an asterisk.

Kind	Film Types Used
35mm	*Plus-X (negative)
Polapack	*Type 107 (positive hardcopy) *Type 105 (positive-negative)
Single Exposure (4x5)	Plus-X (negative) Type 55 (positive-negative) Type 57 (positive hardcopy)

2.1.1 35mm

35mm black and white film also known as Plus X, Pan Film or PXP, usually comes in 6 foot rolls consisting of approximately 36 exposures.

2.1.2 Polaroid

Polaroid film comes in two forms suitable for our camera system: the polapack and the single exposure film.

2.1.2.1 Polapack Film

These packs consist of eight exposures each and may be obtained from the pictorial interface supervisor or the computer operators. Film type 107 produces immediate hardcopy imagery without any negative. However, there is a new film type (105) available which produces a high quality negative when a fixer is applied in addition to the hardcopy image as in type 107. The film and fixer may be obtained from the pictorial interface supervisor or the computer operators. For instructions on the use of positive-negative film contact the pictorial interface supervisor.

There are now 4 polapack camera backs to use with the display camera system - one back for each of the 3 types of film commonly used (b&w - types 105, 107 and color - 108). There may already be film in one of the backs of the type desired. If this is the case, that pack should be completed first. There should not be more than one camera back with any given film type in it at any time. To exchange polapack backs or to load film into one, see sections 1.2.2.2 and 1.2.2.3.

2.1.2.2 Individual Polaroid Exposures

Single polaroid exposures of the same type as polapacks may be used. In addition, the special positive-negative film (type 55) is also available in this form. It produces an instant hardcopy image as well as a negative for future use when a fixer is applied to it immediately after shooting it. Further information concerning this kind of film can be obtained from the pictorial interface supervisor.

2.1.3 Sheet Film

4x5 sheet film is generally used instead of 35mm when only a few images are needed quickly. It also produces better enlargements (most noticeably 8x10s). Also, the original image is generally of better quality than 35mm. Both sheets should be used for the same image with the same settings so the photographic lab can under- or overdevelop the second if the first developed image is not at the right exposure. To have this film loaded, the user should contact one of the photographic staff or the pictorial interface supervisor.

2.2 Color

The 3 kinds of color film compatible with the digital display camera systems are indicated below along with the film types generally used. Those kept in constant supply are marked with an asterisk.

Kind	Film Type Used
35mm	*Ektachrome-X (transparency)
Polapack	*Type 108 (positive hardcopy)
Single Exposure (4x5)	Ektachrome-X (transparency) Type 58 (positive hardcopy)

2.2.1 35mm

The film commonly used is Ektachrome-X. Color transparencies, mounted in 2x2 slide form, are the resulting product. From them, enlarged prints of good quality can be made. This film is usually loaded and ready. If necessary, the pictorial interface supervisor or one of the trained computer operators can load 35mm film when requested by a user.

2.2.2 Polaroid

2.2.2.1 Colorpack Film

Similar to the black and white polapack, this film produces eight 3 1/4" x 4 1/4" immediate hardcopy images. The advantage of the colorpack is an instant color picture which can serve as a check of camera or color settings for image quality. However, no negative is produced for future work with the image. Also, the cost is high compared to 35mm film and processing. These film packs may be obtained from the pictorial interface supervisor or the computer operators any time the system is operational.

2.2.2.2 Individual Exposures

This film is basically the same as the eight exposure cartridge and is used as discussed for black and white film in section 2.1.2.2. It has the advantage of allowing one exposure at a time.

2.2.3 Sheet Film

As with the black and white single exposures, this kind of film is used to produce higher quality (better resolution) images than the 35mm. The instructions and explanations are the same as for the black and white sheets (section 2.1.3).

3.0 Digital Image Photography

This section discusses all the information needed to produce both black and white as well as color imagery using the digital display.

3.1 General Procedures

3.1.1 Setting The F-Stop

(Figure 3-1)

The user should unlatch the hinge on the left side of the photocopy unit and check the lens to see if the F-stop is set to the number listed on the camera setting sheet posted on the digital display bulletin board. For the 35mm lens, the diamond on the second dial from the outside of the lens unit should point to the desired setting on the outer dial. The outer dial must be turned to properly position the setting. For the polaroid lens, the dial must be turned until the desired setting is positioned beneath the arrow located at the lower right side of the dial.

3.1.2 Setting The Refreshes

(Figure 3-2)

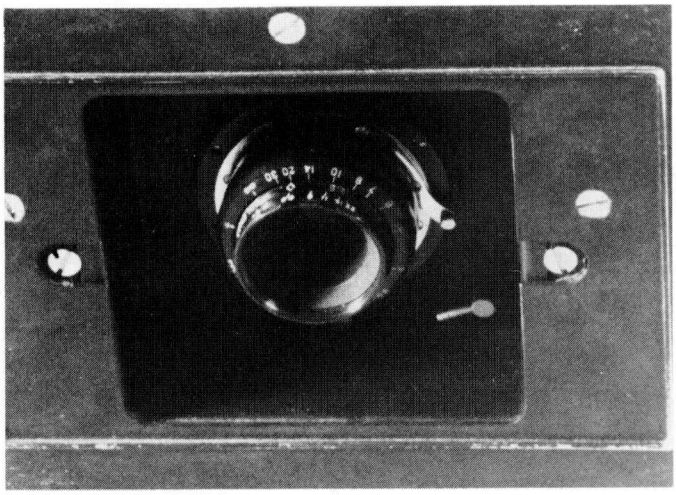
The exposure setting on the photocopy unit must be checked for the proper number of refreshes. The numbers are in binary code. The figure shows several examples of commonly used exposure settings. They range from 1 refresh (the first switch on the right pushed down and all other up), which is the shortest exposure time, to a maximum exposure length of 16 refreshes (all switches pushed up in the zero position). When more than 16 refreshes are necessary, the shutter is operated several times as indicated on the bulletin board camera settings.

3.1.3 Other Photocopy Unit Controls

Located on the photocopy control box are the manual shutter and advance buttons as well as the film expose lamp and mode switch. Their functions are described below:

1. Shutter - Pressing the shutter button exposes the film for the amount of time determined by the number of refreshes selected. It is only pressed once for standard black and white pictures. For color images

35mm



Polaroid

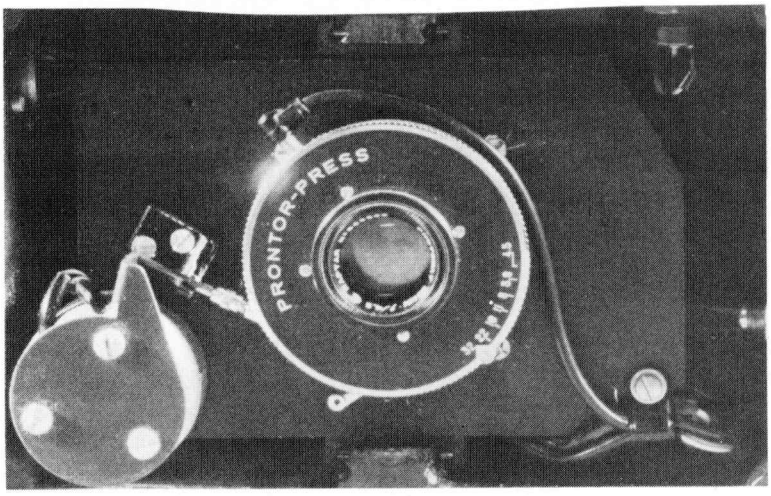
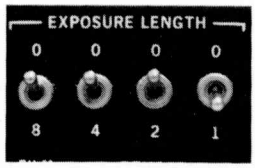
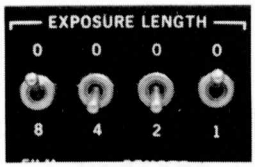


Figure 3-1

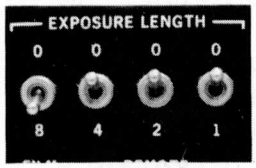
Setting the F-stop



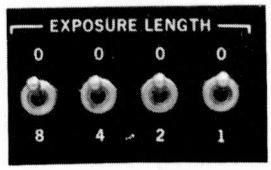
1 Refresh



6 Refreshes



8 Refreshes



16 Refreshes

Figure 3-2
Setting the Refreshes

Figure 3-3
The Photocopy Unit Control Box

and sometimes positive-negative film, multiple exposures are required. The number of exposures is posted on the bulletin board by the photocopy unit. The shutter and advance functions work independently of each other; therefore, it is possible to use as many shutter openings as necessary without advancing the film.

2. Advance - Once the desired image has been completed, the film must be advanced manually by pressing the advance button. This applies only to the 35mm film. The polaroid polapacks are "advanced" as described in section 1.2.2.2. The single exposure films need advancing, but are simply removed after the exposure has been taken.

3. Film Exposed Lamp - After the shutter button has been pushed, the film exposed lamp glows. It will remain lit until the advance button is pushed. This serves as a check to see if your film has been advanced after each picture.

4. Mode Switch - In general, this switch should be set in the local position; otherwise, the camera will not operate. The only time the remote setting is used is when the PHOTO program is automatically operating the 35mm camera.

3.1.4 Operations Checklist

When the desired image is on the screen, ready to be photographed, the user should:

1. Check the lens setting (F-stop).
2. Check the number of refreshes.
3. Be certain the camera and magazine are firmly locked in place.
4. Pull the dark slide (Figure 1-3) out far enough to expose the film.
5. Insert color filters if necessary (see section 3.3.1.3).
6. Be certain the filter holder door is secured.
7. Operate the shutter the required number of times.
8. Advance film when the image is complete. For color film, steps 5-7 must be followed three times (once for each filter-image combination) before the film is advanced.

3.2 Black And White Photography

This section gives a thorough description of the techniques involved in producing black and white digital imagery.

3.2.1 Camera Usage

Camera settings are posted on the bulletin board by the digital display. The following sections give information about producing images for each of the various types of film and camera equipment used.

3.2.1.1 35mm

Any picture taken within the F-stop range indicated should produce good results. See section 3.1 on proper settings. After each picture taken, the user should enter the appropriate information on a 35mm black and white film log sheet (see section 5.0).

3.2.1.2 Polaroid (Polapack Or Individual Exposures)

The F-stop setting is approximate and may vary with different scenes. If a change in setting is needed, the user should refer to section 4.0, "How to Correct Under- or Over-exposed Images". After the shutter button is pressed, pull out the white paper on the right side of the camera. Start timing now. When time is up the user must pull the finished image away from the paper and coat the image immediately using the grey tube of fixer enclosed with each pack. If a pack was previously loaded, the tube should be near the display. Sufficient time should be allowed for the image to dry before storing (at least several minutes). Polaroid images are for personal use. No record needs to be kept of them.

The individual polaroid films use the same settings as the polapack. However, the film is inserted into the individual polaroid holder (see Figure 1-5) following the procedure described on the polaroid holder. The holder is then loaded into the 4x5 camera back as for sheet film in section 3.2.1.3. The film is then ready to be used.

3.2.1.3 Film Sheets

Both sheets should be exposed to the same image using the same settings (see section 2.1.3). To expose the first film, the L-shaped latch should be turned to release the dark slide nearest to the lens unit and that slide pulled out. Notice that both slides have a silver edge on their right edge facing away from the center of the film holder. This implies that the film is unexposed. After the user has removed the slide and pushed the shutter button, this dark slide should be replaced with the silver edge toward the center of the holder (black edge facing out). By following this procedure, the photographic staff will know whether or not the film has been exposed.

To expose the second sheet, the film holder must be removed from the back and flipped over so that the unexposed sheet is facing toward the lens unit. The process followed for the first exposure is then repeated. Turning the L-shaped latches on the right side of the holder will secure both slides. The film holder should then be returned to the photographic lab for development. Be sure to leave name, film type, and exposure information (F-stop, refreshes) with it.

3.3 Color Enhanced Photography

This section gives a complete description of the techniques involved in producing color digital imagery from the digital display.

3.3.1 General Procedures

Section 3.1 on general procedures applies to color imagery; however, the color process is somewhat more involved since three filter-channel combinations are necessary to produce one image. The following is an explanation of the special techniques involved in producing a color image.

3.3.1.1 The Three-Step Process

There are basically three stages involved in taking a single color image. These correspond to the three filter-channel combinations mentioned above. They are as follows:

A. Blue Filter - A channel corresponding to the blue-green range of the spectrum is chosen to be displayed on the screens. In data, channel 1 (MSS band 4, .5-.6 micron) would be the proper channel. When the data is displayed, the blue filter is inserted and the shutter is operated the required number of times as described on the digital display bulletin board. The film is not advanced yet.

B. Green Filter - A channel corresponding to the green-red range of the spectrum should be displayed as the filter is being loaded. Channel 2 (MSS band 5, .6-.7 micron) of data is used. The shutter should be pressed the required number of times.

C. Red Filter - The same procedure is followed as for parts A and B using a red filter and a channel in the near infrared region of the spectrum. Either channel 3 or 4 of data (MSS bands 6 and 7, .7-.8 micron and .8-1.1 micron respectively) can be used.

After all three stages are completed, the film can be advanced. It makes no difference what order the three steps are done in as long as the proper filter-channel combination and corresponding shutter (exposure) settings are used.

3.3.1.2 The F-Stop Setting

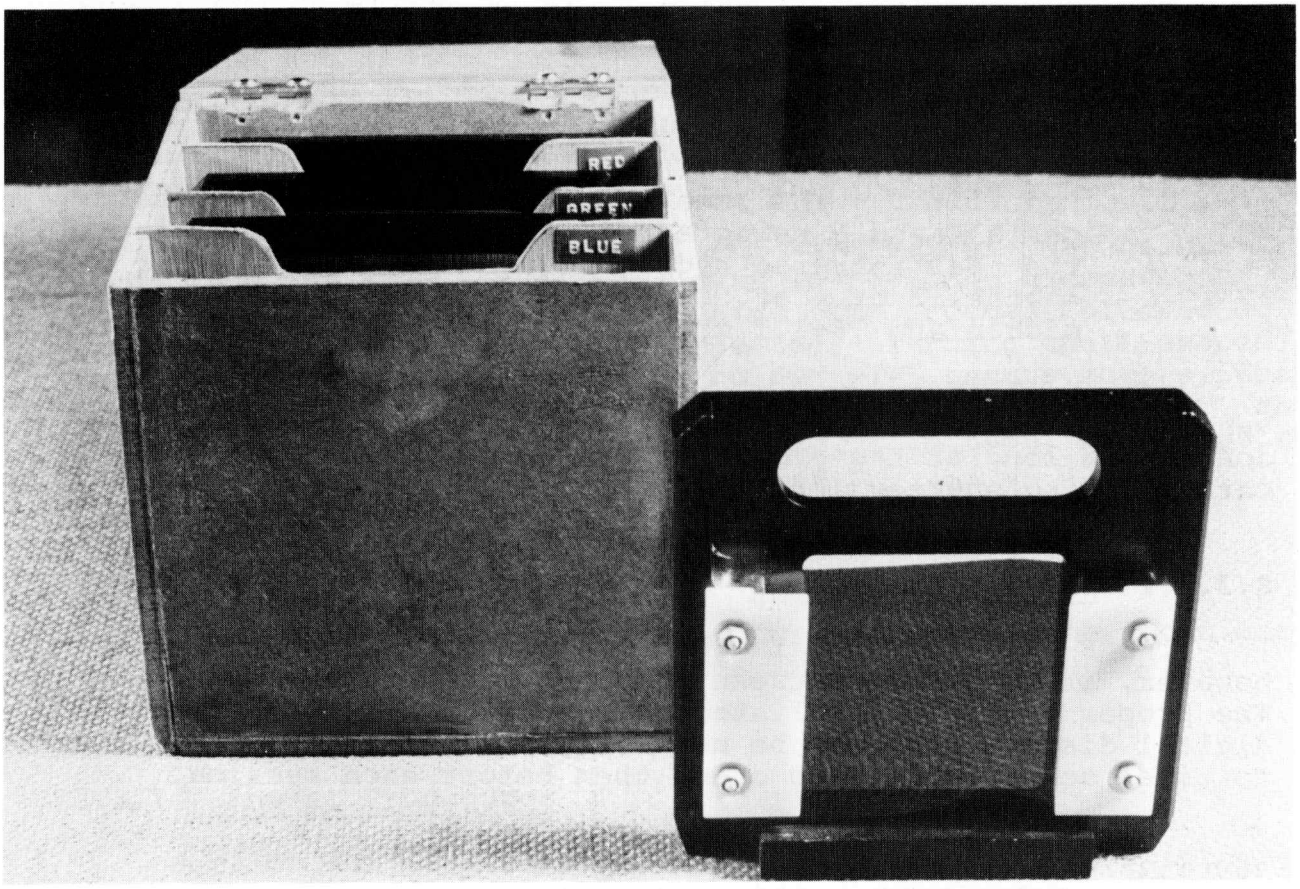
The F-stop will remain the same for all three sequences; however, it does vary between 35mm and polaroid photography. The proper settings are listed on the information sheet by the digital display. It may be necessary to revise these from time to time, so be certain to check them before each session.

3.3.1.3 The Filters

(Figure 3-4)

To load the color filters into the camera unit, the user should first check the dark slide to see that it is covering the aperture. He may then open the door on the top of the black photocopy unit mount by turning the latch and lifting. Inside there are vertical grooves just wide enough for the filter casing to fit snugly inside. The first desired filter should be removed from the wooden filter box and, gripping it by the handle on top, it should be slid down between the grooves until it clicks in place. After screwing down the lid securely, the camera is now ready to shoot the first channel.

Filter Box



Filter Holder

Figure 3-4
The Color Filters

3.3.1.4 The Entire Color Image Operation

The user must:

A. Adjust the F-stop and refresh settings as indicated.
B. Pull the dark slide out as far as the vertical etched line (approximately 6 inches).
C. Display a channel of data while inserting the proper filter.
D. Press the shutter button the required number of times for this channel.
E. Remove the filter.
F. Enter the next channel of data and repeat steps C through E.
G. After all three channels have been photographed, advance the film.

During this operation, it is very important that the camera unit (particularly the film magazine) is not jiggled or moved any more than necessary. If the film is displaced at all from its position at the beginning of the process, the final image will be blurred.

3.3.2 Photographing Classification Results

There is a separate program for photographing classification results known as PHOTO. For complete instructions regarding the operation of this program, the user should consult LARS Program Abstract #649 and section 2.2 of PART I of this guide.

The basic photography for PHOTO is no different from the procedure for color enhanced images. Any of the camera units can be used. However, instead of specifying a certain channel to be displayed for each filter, the program will display automatically an appropriate grayscale for each filter to produce the colors specified for each class of the results. The possible colors and corresponding numbers are on the photocopy unit bulletin board.

Under the PHOTO program, the 35mm camera can be used either manually, as for regular color enhanced images, or automatically, where the program operates the shutter and advance buttons. When the automatic sequence is used, the mode switch on the photocopy control box (see section 3.1.3, number 4) must be set to remote. For all other cases, the local mode is used.

3.3.3 Camera Usage

Camera settings are posted on the bulletin board by the photocopy unit. The following sections give information about producing images for each of the various types of film and camera equipment used.

3.3.3.1 35mm

Using the color procedure given above the user should refer to section 3.2.1.1 for proper usage of the 35mm camera. For each image taken, the appropriate information should be entered in the color 35mm film log, section 5.0. Also, the total number of exposures used should be marked on the exposure sheet on top of the film magazine.

3.3.3.2 Polaroid (Colorpack And Individual)

Following the preceding color procedure, the user should refer to section 3.2.1.2 for proper usage of the polaroid equipment. No coating is necessary for the color polaroid images. It may also be helpful to read about proper development time in the colorpack instructions.

3.3.3.3 Film Sheets

The user should follow the same procedure described for 35mm color film. Also, reading section 3.2.1.3 on loading and exposing sheet film is recommended.

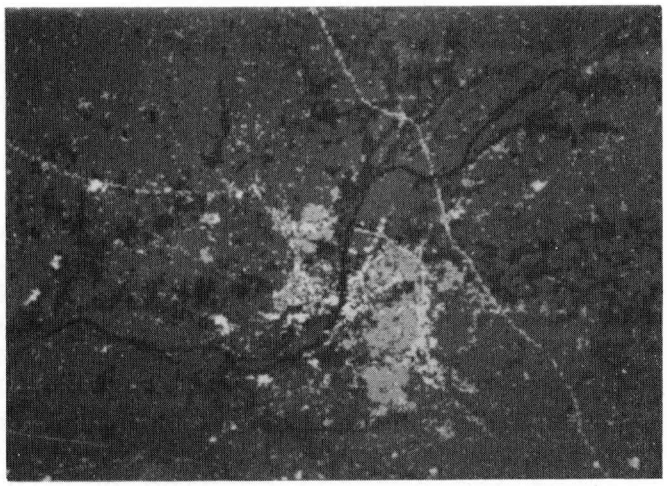
4.0 How To Correct Under - Or Overexposed Polaroid Images

For 35mm imagery, the settings listed on the photocopy unit bulletin board should hold for all imagery. However, if by using these settings, any images seem to be improperly exposed, they should be brought to the attention of the pictorial interface supervisor.

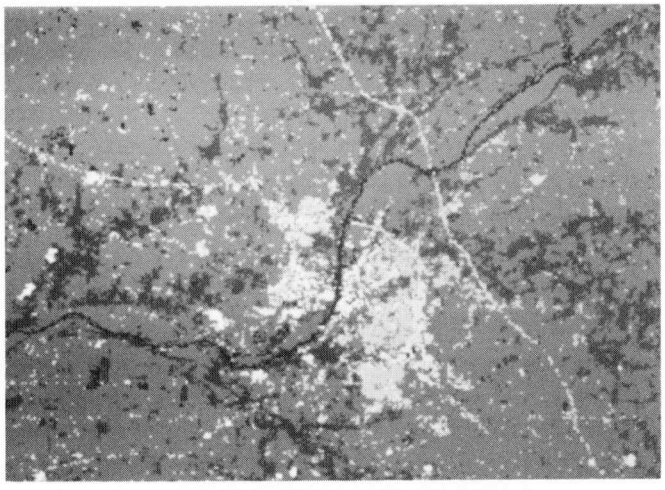
For polaroid pictures, the exposures required may vary from one scene to another. As figure 4-1 shows, if the image is too dark, or underexposed, the F-stop should be set to a slightly lower number. For example, if the original setting was *f*32+(example A), the user might try resetting it to *f*32 (example B). If the image is too light, or overexposed, (example C) changing the setting to a higher number will correct the exposure. The proper setting should fall between *f*22 and the highest setting possible, beyond *f*32. If any image must be exposed beyond this range, the pictorial interface supervisor should be contacted.

Poor results may also be caused by a faulty pack of film, in which case the pictorial interface supervisor should be contacted to reimburse the user for the pack. If the user suspects the film pack or any part of the camera unit is at fault, he should retain the poor images for the pictorial interface supervisor to determine the precise cause of the problem.

Example A
Underexposed
Setting: *f*32+



Example B
Correct Exposure
Setting: *f*32



Example C
Overexposed
Setting: *f*22

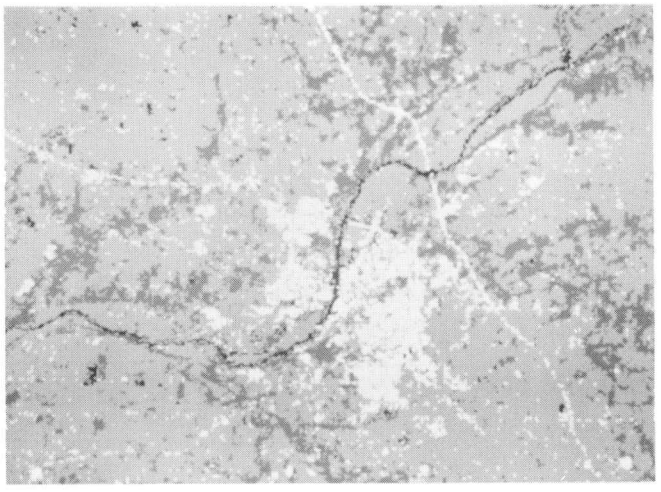


Figure 4-1
Correcting Polaroid Image Exposures

5.0 The Permanent Imagery

(Figures 5-1, 5-2 and 5-3)

In order to keep a permanent record for LARS of all permanent digital display imagery, the form sheet devised to be used when taking photographs should be filled out. This sheet requests all information which might be pertinent to other users referring to the logs.

There are basically three different types of sheets: 35mm color, 35mm black & white, and Polaroid positive-negative imagery. The top of each sheet requests basic information concerning a given run. All exposures listed under this heading should be on one particular tape and file. For each different run photographed, a separate sheet must be used. Carbon paper is included with each tablet so that a user can make a copy for his own record. On these sheets, an effort has been made to incorporate all information which a user would normally wish to mark down for his own reference. In this manner, there should be a minimum of additional information which a person might wish to include.

When the user's session at the terminal is finished, the original log sheet (s) should be slipped into the Imagery Log

BLACK & WHITE 35 mm Film Log

DATE 10/29/75 PROJECT DIGITAL DISPLAY USER Wilson ERTS ☒
RUNN 72073408 IMAGE LOCATION Houston, Texas SKYLAB ☐
AREA HISTOGRAMMED Line ____ Col ____ OTHER ____
Classification Results: V3: TAPE 540 FILE 13-15 (V2: Serial ____)

	SCALE*	CHNL. FILES	AREA DISPLAYED LINES	COLS	COMMENTS (Scene Features, Data, Conditions, etc.)
1	4/1	13	(all		SAM HOUSTON
2	4/1	14	data		NATIONAL
3	4/1	15	sets)		FOREST
4	/	—			
5	/	—			
6	/	—			
7	/	—			
8	/	—			
9	/	—			
10	/	—			
11	/	—			
12	/	—			

3 Total Number of frames advanced(include blank frames, too)
*(Pixel/Data Point)

Figure 5-1

Black & White 35mm Film Log Sheet

envelope on the digital display bulletin board.

For 35mm film remember that the total number of exposures listed on the sheet attached to a camera back must still be provided. This number serves two purposes: it insures that no pictures will be lost due to being too close to the end of the film, and it facilitates processing.

The following is a brief description of some of the information requested on the sheets:

DATE - present date

PROJECT - A computer ID is sufficient.

USER - the user's name

SKYLAB, OTHER - Indicate type of data. If it is classification results, 'results' should be written in for OTHER and type of data used (etc.) indicated.

RUNN - run number of the data set

IMAGE LOCATION - state, nearest town, region, etc.

Color 35mm Film Log

DATE 2/6/75 PROJECT PY USER M. Fleming ERTS ☑ SKYLAB ☐

RUNN 73046414 IMAGE LOCATION Central Indiana OTHER

AREA HISTOGRAMMED LINE 1100-2348-4 COL 1000-1550-2

Classification Results: V3: TAPE FILE (V2: Serial)

	SCALE*	AREA DISPLAYED LINES	COLS	COMMENTS (Scene Features, Data, Conditions, etc.)
1	1/1	1-577	1656-2422	River in center; Road Xing on Right
2	1/1	500-1076	1656-2422	Reservoir on Top Bad data lines
3	1/1	500-1076	954-1720	Kokomo lower Right
4	1/1	1000-1576	954-1720	I65 in SW
5	1/1	1500-2076	954-1720	Indianapolis on Right
6	1/	13 LANDSAT		ADVANCE
7	1/			
8	1/			
9	1/			
10	1/			
11	1/			
12	1/			

6 Total Number of frames advanced (includes blank frames, too)

*(Pixel/Data Point)

Figure 5-2

Color 35mm Film Log Sheet

AREA HISTOGRAMMED - (lines, columns) only if information is readily available.

CLASSIFICATION RESULTS - serial applies only to LARSYS Version 2.

The following sections in the bottom half of the sheet apply to each of the three types:

SCALE - The number of pixels (picture elements/data point interval) currently being displayed on the screen. (i.e. a full frame would be displayed at scale 1/5 or 1 pixel representing every 5th data point.)

AREA DISPLAYED - line and column coordinates

COMMENTS - These can include any useful information such as -

SCENE FEATURES - examples: farmland, mountains, prominent towns or roads, water bodies.

DATA CONDITIONS - indicate bad data by channel, may also include here cloud cover or other such pertinent data.

Polaroid POSITIVE-NEGATIVE Film Log

DATE 9/4/75 PROJECT SKYLAB - COLORADO USER Svedlow ERTS ☑ SKYLAB ☐

RUNN 73034313 IMAGE LOCATION COLORADO OTHER

AREA HISTOGRAMMED Line Col

Classification Results V3 TAPE 601 FILE 2 (V2 Serial)

	SCALE*	CHNL.	AREA DISPLAYED LINES	COLS	COMMENTS (Scene Features. Data. Conditions. etc.)
1	1/1	6	(entire		(Mountainous
2	1/1	7	data		Area
3	1/1	16	set		Slope Classification)
4	/				
5	/				
6	/				
7	/				
8	/				

*(Pixel/Data Point)

NOTE To keep Negatives in sequence
Place them in order in numbered compartments
☒ Check here if you wish them numbered
Give tank with this sheet attached to Leslie Wilson immediately

Figure 5-3

Polaroid Positive-Negative Film
Log Sheet

The following information pertains only to the black & white film, either 35mm or Polaroid Positive-negative:

CHNL - data set channel used to photograph the image.

For positive-negative film, the box at the bottom of the exposure sheet should be checked for those who wish to have their negatives numbered sequentially. For instructions concerning the usage of this type of film, see section 6.3.

6.0 Development And Processing

This section applies only to 35mm, 4x5 sheet film and positive-negative film, The discussion below applies to both black and white and color film.

6.1 35mm

The Ektachrome-X film is regularly taken from the camera and sent through photographic service for development. This occurs when:

1. The end of a roll of film is reached,
2. every Monday morning,
3. a user requests a film change or requires immediate development.

Every effort will be made to have color film processed by the end of the week. Black and white film will be processed according to the LARS photographic staffs' scheduling. If a user needs immediate processing of some imagery, he must first see the head of the photographic staff to find out how soon development can be done. Then, if the roll of film needs to be taken out of the camera prematurely, the user should have it done by either the pictorial interface supervisor or one of the trained computer operators.

Once the film has been developed, it will be divided according to the users who took the images (following the exposure sheet). Color film will be mounted in slide form at this point and black and white negatives placed in sheet holders. These products will then be returned to the user. If the imagery has not been received within a week and a half after taking it, or if the wrong pictures have been forwarded, the pictorial interface supervisor should be contacted. A copy of the permanent imagery log sheet would be of use in locating the imagery if any problems should arise.

6.2 4x5 Sheet Film

After photographing the two images per film holder, the user should attach a piece of tape to each holder with his name, computer ID and date on it. It should then be returned to the photographic lab for processing. Be certain the latches are holding the slides in place and that the silver edge of each slide is facing in.

If the images have not been returned to the user within one week, the photographic staff should be contacted.

6.3 Polaroid Positive-Negative Film

Positive-negative film is a fairly simple means of producing high quality negatives in a very brief period of time. The process differs from handling the other polapack film types in the clearing of the negative. The positive image is still separated from its backing as with other types except that the backing contains the negative. This negative must be placed immediately in a clearing tank by the user. (Tanks may be obtained with the film from a computer operator.) When all of the negatives have been placed in the tank, it (or they) along with the imagery log sheet should be given to the pictorial interface supervisor. The negatives will then be returned to the user within two days.

The following points should be remembered when clearing negatives:

1. The user must exercise care in handling the negatives to avoid any injury to them. The instructions enclosed with each film pack should be consulted.

2. When processing imagery the instructions on the tank lid should be followed.

3. The tank should be given to the supervisor immediately since negatives cannot be left in the solution for longer than 48 hours.

4. If the negatives are to be numbered in sequence during final processing:

   - place the negatives in their proper numbered compartments in the tank
   - check ☑ the box at the bottom of the log sheet to indicate that the images are to be numbered.

5. If the negatives have not been received within 2 days, the pictorial interface supervisor should be contacted immediately.

6.4 Further Processing

If, after receiving the imagery, duplicates, prints, enlargements, or any other products are to be made from them, a work order should be obtained through the photographic staff.

PERSONNEL LIST

As of October, 1975

Computer Operations Manager	Bill Hockema
Digital Display Applications Group	Leslie Wilson
	Donna Scholz
Photographic Department	Dick Mroczynski
Full-Time Senior Computer Operators	Mike Collins
	Doug Shields
Computer Operators trained to handle the digital display camera equipment	Mike Collins
	Bruce Eisert
	Bob Meyer
	Doug Shields
	Chuck Smith
	Willard Moseng

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